# GREAT BASIN UNIFIED
# AIR POLLUTION CONTROL DISTRICT

# QUALITY ASSURANCE PROJECT PLAN

For

# PM10, Meteorological, and Sand Flux Monitoring

**Revision 2**

**JUNE 2013**

## 1.0 Quality Assurance Project Plan Identification and Approval

Title: Great Basin Unified Air Pollution Control District (GBUAPCD) Quality Assurance Project Plan (QAPP) for PM10, Meteorological, and Sand Flux Monitoring Program at State and Local Air Monitoring Stations (SLAMS)

The attached QAPP for the PM10, Meteorological, and Sand Flux Monitoring Program is hereby recommended for approval and commits the District to follow the elements described within.

**Great Basin Unified Air Pollution Control District**

1) Signature: ______________________________________________ Date:_______
Duane Ono - Deputy Air Pollution Control Officer

**California Air Resources Board**

1) Signature: ______________________________________________ Date:_______
Mike Miguel – Chief, Quality Management Branch

2) Signature: ______________________________________________ Date:_______
Ranjit Bhullar - Manager, Quality Assurance Section

**U.S. EPA Region IX**

1) Signature: ______________________________________________ Date:_______
Matthew Lakin, Ph.D. - Chief, Air Quality Analysis Division

2) Signature: ______________________________________________ Date:_______
Michael Flagg - Air Quality Analysis Office

# Acronyms and Abbreviations

| | |
|---|---|
| AIRS | Aerometric Information Retrieval System |
| AMTAC | Air Monitoring Technical Advisory Committee |
| ANSI | American National Standards Institute |
| AQS | Air Quality System |
| ARB | Air Resources Board, State of California |
| ASTM | American Society for Testing and Materials |
| AWMA | Air and Waste Management Association |
| °C | Temperature, in degrees Celsius |
| CAA | Clean Air Act |
| CARB | State of California Air Resources Board |
| CFR | Code of Federal Regulations |
| DAS | data acquisition system |
| DQA | data quality assessment |
| DQOs | data quality objectives |
| Dust ID | Dust Identification Program |
| EQPM | Federal equivalent method designation |
| FEM | Federal equivalent method |
| FRM | Federal reference method |
| GBUAPCD | Great Basin Unified Air Pollution Control District |
| GIS | geographical information systems |
| GLP | good laboratory practice |
| GPS | global positioning system |
| hPa | Hecto-Pascals, standard international unit of pressure, equivalent to millibars |
| HVAC | heating ventilation and air conditioning |
| LPM | liters per minute |
| MOU | Memorandum of Understanding |
| MQOs | measurement quality objectives |
| NAAQS | National Ambient Air Quality Standards |
| NAMS | national air monitoring station |
| NCORE | National Core monitoring network |
| NIST | National Institute of Standards and Technology |
| NPAP | National Performance Audit Program |
| OTM30 | Other Test Method 30 |
| PFA | perfluoroalkoxy Teflon |
| PM2.5 | particulate matter $\leq$ 2.5 microns |
| PM10 | particulate matter $\leq$ 10 microns |
| PM10-2.5 | coarse particulate matter $\geq$2.5 microns and $\leq$ 10 microns |
| POC | pollutant occurrence code |
| PTFE | polytetrafluoroethylene |
| $Q_a$ | sampler flow rate at ambient (actual, volumetric) conditions of temperature and pressure. |
| QA | quality assurance |
| QA/QC | quality assurance/quality control |

| | |
|---|---|
| QAPP | quality assurance project plan |
| QMP | quality management plan |
| Qstd | sampler flow rate at standard conditions of 25°C and 1013 hPa |
| RFPS | Federal reference method designation |
| R&P | Rupprecht & Patashnick |
| SIP | State Implementation Plan |
| SLAMS | state and local air monitoring stations |
| SOP | standard operating procedure |
| SPM | special purpose monitor |
| $T_a$ | temperature, ambient |
| TEOM | Tapered element oscillating microbalance |
| TSP | total suspended particulate |
| U.S. EPA | United States Environmental Protection Agency |
| $V_a$ | air volume, at ambient, actual, or volumetric conditions |
| VOC | volatile organic compound |

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## 3.0 Distribution List

A copy of this QAPP has been distributed to the individuals in Table 3-1.

**Table 3-1 Distribution List**

GREAT BASIN STAFF

| | | |
|---|---|---|
| Mr. Theodore D. Schade<br>Air Pollution Control Officer | Mr. Duane Ono<br>Deputy APCO | Mr. Nik Barbieri<br>Director of Technical Services |
| Mr. Christopher Lanane<br>Air Monitoring Specialist | Mr. Dan Johnson<br>Air Monitoring Technical Specialist | Mr. R. Guy Davis<br>Air Monitoring Technician II |
| Ms. Valerie Thorp<br>Air Monitoring Technician II | Mr. Scott Weaver<br>Air Monitoring Technician II | Mr. Steve Mobley<br>Air Monitoring Technician II |
| Ms. Susan Determann<br>Air Monitoring Technician II | Mr. Phill Kiddoo<br>Senior Research & Systems Analyst | Mr. Chris Howard<br>Research & Systems Analyst II |

CALIFORNIA AIR RESOURCES BOARD STAFF

| | | |
|---|---|---|
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| PTSD<br>AQDB Chief<br>Ms. Karen Magliano | MLD<br>QMB, Chief<br>Mr. Mike Miguel | MLD<br>AQSB, Chief<br>Mr. Ken Stroud |
| MLD<br>QAS Manager<br>Mr. Ranjit Bhullar | MLD<br>AQSB<br>Mr. Patrick Rainey | MLD<br>AQSB<br>Mr. Chris Deidrick |

US EPA STAFF

| | | |
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| U.S. EPA Region IX<br>Air Quality Analysis Chief<br>Mr. Matthew Lakin, Ph.D. | U.S. EPA Region IX<br>Ms. Meredith Kurpius, Ph.D. | U.S. EPA Region IX<br>Mr. Matthew Plate |
| U.S. EPA Region IX<br>Mr. Michael A. Flagg | | |

## 4.0 Project/Task Organization

### 4.1 Roles and Responsibilities

Federal, State, and local agencies all have important roles in developing and implementing satisfactory air monitoring programs. As part of the planning effort, U.S. EPA is responsible for developing National Ambient Air Quality Standards (NAAQS), defining the quality of the data necessary to make comparisons to the NAAQS, and identifying a minimum set of QC samples from which to judge data quality. The State and local organizations are responsible for taking this information and developing and implementing a system that will meet the data quality requirements. Then, it is the responsibility of both U.S. EPA and the State and local organizations to assess the quality of the data and take corrective action when appropriate. The responsibilities of each organization are presented below.

#### 4.1.1 Office of Air Quality Planning and Standards (OAQPS)

OAQPS is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with U.S. EPA's Regional Offices and the states, enforces compliance with the standards through state implementation plans (SIPs) and regulations controlling emissions from stationary sources. The OAQPS evaluates the need to regulate potential air pollutants and develops national standards; works with State and local agencies to develop plans for meeting these standards; monitors national air quality trends and maintains a database of information on air pollution and controls; provides technical guidance and training on air pollution control strategies; and monitors compliance with air pollution standards.

The Monitoring and Quality Assurance Group (MQAG), within the OAQPS Emissions Monitoring and Analysis Division, is responsible for the oversight of the nation's Ambient Air Quality Monitoring Network. The MQAG:

- ensures that the methods and procedures used in making air pollution measurements are adequate to meet the programs objectives and that the resulting data are of satisfactory quality
- operates the National Performance Audit Program (NPAP) and the FRM Performance Evaluation
- evaluates the performance, through technical systems audits and management systems reviews, of organizations making air pollution measurements of importance to the regulatory process
- implements satisfactory quality assurance programs over U.S. EPA's Ambient Air Quality Monitoring Network
- ensures that national regional laboratories are available to support chemical speciation and QA programs
- ensures that guidance pertaining to the quality assurance aspects of the Ambient Air Program are written and revised as necessary, and,
- renders technical assistance to the U.S. EPA Regional Offices and air pollution monitoring community.

### 4.1.2 U.S. EPA Region IX Office

U.S. EPA Regional Offices have been developed to address environmental issues related to the states within their jurisdiction and to administer and oversee regulatory and congressionally mandated programs. The major quality assurance responsibilities of U.S. EPA's Region IX Office, with regard to the Ambient Air Quality Program, include the coordination of quality assurance matters at the Regional levels with the State and local agencies. This is accomplished by the designation of U.S. EPA Regional Project Officers who are responsible for the technical aspects of the program including:

- review of QAPPs by Regional QA Officers who are delegated the authority by the Regional Administrator to review and approve QAPPs for the Agency
- review of annual air quality network monitoring plans from agencies under their purview for compliance with Code of Federal Regulations requirements
- support the FRM Performance Evaluation Program
- evaluate quality system performance, through technical systems audits and network reviews whose frequency is addressed in the Code of Federal Regulations and Section 20
- act as liaisons by making available the technical and quality assurance information developed by U.S. EPA Headquarters and the Region to the State and local agencies, and make U.S. EPA Headquarters aware of the unmet quality assurance needs of the State and local agencies

### 4.1.3 California ARB

The ARB's mission is to promote and protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the State. By legislative mandate, the ARB has oversight of California's air pollution control program with the responsibility for improving and maintaining the air quality in the State. California ARB will direct technical and QA questions to Region IX.

40 CFR Part 58 defines a State Agency as "the air pollution control agency primarily responsible for the development and implementation of a plan (SIP) under the Act (CAA)." Section 302 of the CAA provides a more detailed description of the air pollution control agency.

### 4.1.4 Great Basin Unified Air Pollution Control District

40 CFR Part 58 defines the Local Agency as "any local government agency, other than the state agency, which is charged with the responsibility for carrying out a portion of the plan (SIP)."

The major responsibility of State and local agencies is the implementation of a satisfactory monitoring program, which would naturally include the implementation of an appropriate quality assurance program. The Great Basin Unified Air Pollution Control District (District) is the responsible local agency for Inyo, Mono, and Alpine Counties including four (4) nonattainment areas for PM-10: the Owens Valley, the Town of Mammoth Lakes, the Mono Basin, and Coso Junction.

The District is charged with the protection of the public health and welfare from the adverse affects of air pollution for the citizens of Inyo, Mono, and Alpine Counties in Eastern California. To this end, it is the District's responsibility, in conjunction with the ARB and the EPA, to develop long-range comprehensive programs, including state implementation plans (SIPs), to achieve and maintain federal and state air quality standards. The District is responsible for the implementation of the air quality monitoring program and the enforcement of federal, state, and local rules and regulations governing air quality at the local level.

The District is delegated authority by the federal and state regulatory agencies to implement a comprehensive quality assurance program covering all aspects of the air quality monitoring program, to be reviewed by state and local air pollution authorities. Under this authority, the District's air quality monitoring responsibilities include: 1) the determination of monitoring locations; 2) operation, maintenance, and calibration of field monitors; 3) operation, maintenance, and calibration of laboratory equipment used for filter processing; 4) internal quality assurance audits of monitoring equipment; and, 5) reporting of the collected data to local, state, and federal databases.

The organizational structure of the District is shown in Figure 4.1. The organizational structure of the District staff operating under this QAPP is presented in Figure 4.2.

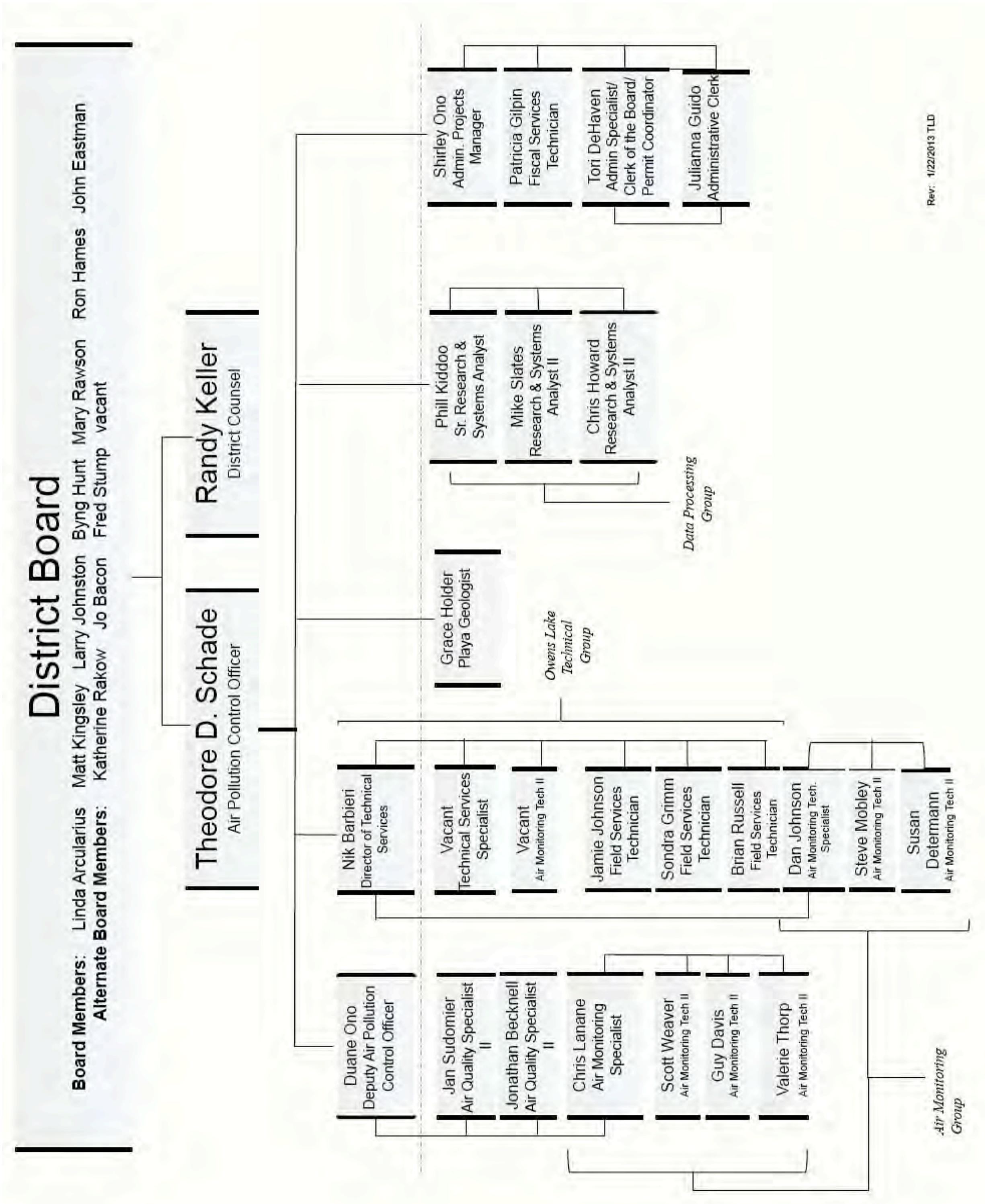


**Figure 4.1 District Organizational Chart**

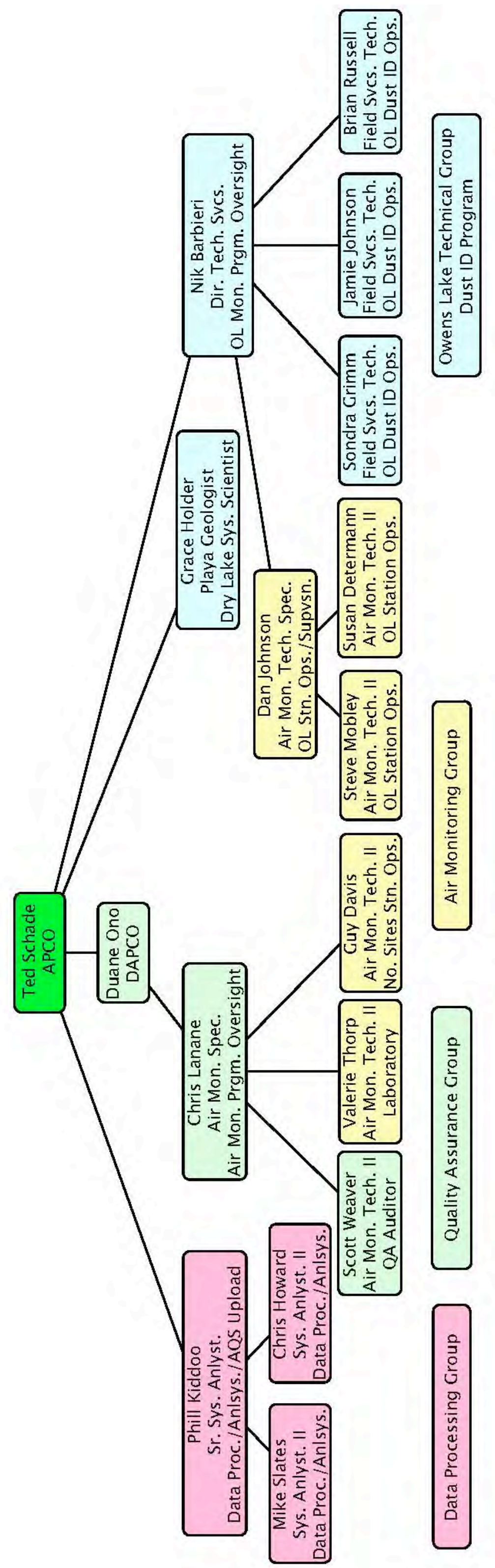


**Figure 4.2 QAPP Staff Organizational Chart**

The Air Monitoring group handles all of the air quality and meteorological monitoring throughout the District that includes: filter-based and continuous particulate matter (PM) monitoring, pollutant gas continuous monitoring, and meteorological monitoring. The AM group also operates and maintains the District's ARB-certified PM-2.5 laboratory, in which all of the PM filters collected throughout the District are processed.

A subset of the AM group, the Quality Assurance group (QAG) conducts internal quality assurance (QA) audits of the monitors throughout the network. The QA auditor conducts no routine monitoring activities and utilizes equipment that is produced and certified by a different manufacturer than that used by staff conducting routine monitoring operations. This subset of the AM group consists of dedicated staff responsible for auditing the District's PM monitors on a quarterly basis and the meteorological sensors on a semiannual basis. The audit staff produces a report after each audit that is submitted to the air monitoring specialist and the instrument technician responsible for site operations at the station audited. The AM group will also participate in the EPA National Performance Audit Program (NPAP) for PM-10 monitors. The ARB currently conducts annual audits of the monitors and sensors throughout the network and of the District's laboratory. EPA IX contractors conduct audits of the PM monitors annually as well.

The Owens Lake Technical (OLT) group installs, maintains, and operates air quality, sand motion, and meteorological monitoring equipment associated with the Dust Identification Program (Dust ID) that is used to define and quantify the emission from dust emissive areas on exposed playa throughout the District.

The Data Processing (DP) group is involved in the processing, validation, and analysis of all of the air quality data collected throughout the District, including PM data, continuous monitor data, sand motion monitoring data from the Dust ID network, and meteorological data. They are responsible for uploading validated data to the EPA's Air Quality System (AQS) database, and for archiving the data at the District offices.

#### 4.1.4.1 Personnel

The people involved in the District's PM-10 monitoring program and their responsibilities relating to that program are described in detail below.

**Air Pollution Control Officer – Mr. Theodore D. Schade, P.E.**

Mr. Schade serves the Great Basin Unified Air Pollution Control District Board of Governors as the chief administrator of the District, overseeing all District activities.

**Deputy Air Pollution Control Officer - Duane Ono**

The Deputy Air Pollution Control Officer oversees permitting and inspection activities of the District as well as the QA and Lab personnel responsible for air quality monitoring, quality control, and quality assurance for the District, including: installation, operation, maintenance, calibration, internal quality assurance auditing of all District monitoring and laboratory equipment. The Deputy APCO is also involved in air quality and Dust Identification monitoring program design at Owens Lake and Mono Lake and in the modeling and analysis of the data collected throughout the District.

**Director of Technical Services – Nik Barbieri**

The Director of Technical Services is responsible for oversight of the Keeler field office and all of the Owens Lake monitoring programs. These programs include: the air quality monitoring program consisting of a network of permanent and portable PM monitors and meteorological sensors and the sand motion monitoring network known as the Dust Identification program. The Director of Technical Services is responsible for:

- overseeing Owens Lake air monitoring technicians
- direct supervision of field services technicians
- sand motion monitoring siting, permitting
- video monitoring of dust source areas
- conducting dust-source area delineation
- monitoring station siting, permitting, and installation in the Owens Lake network
- monitoring station design and construction
- overseeing field sampler installation, operation, maintenance, and calibration
- overseeing field data collection and validation
- internal quality assurance activities relating to Owens Lake monitoring
- acting as liaison between the District and other regulatory agencies on air quality monitoring issues specific to Owens Lake

**Air Monitoring Specialist - Christopher Lanane**

The Air Monitoring Specialist supervises the day-to-day operation of the District's monitoring networks in areas of the District other than the Owens Lake monitoring network. The Air Monitoring Specialist's responsibilities include participating in and overseeing all activities in Alpine, Mono, and Northern Inyo Counties relating to:

- supervision of air monitoring technicians
- monitoring station siting, permitting, and installation
- monitoring station design and construction
- field sampler installation, operation, maintenance, and calibration
- laboratory systems operation
- laboratory sample handling and analysis
- field data collection and validation
- internal quality assurance activities
- acting as liaison between District and other regulatory agencies on air quality monitoring issues
- quality assurance program plan documentation and development

**Air Monitoring Technical Specialist – Dan Johnson**

The Air Monitoring Technical Specialist supervises the day-to-day activities specific to the Owens Lake and Coso Junction monitoring programs. Those responsibilities include:

- supervision of Owens Lake and Coso Junction air monitoring technicians
- monitoring station siting, permitting, and installation
- monitoring station design and construction
- field sampler installation, operation, maintenance, and calibration
- field data collection and validation
- internal quality assurance activities
- acting as liaison between District and other agencies on air quality monitoring issues
- assisting in quality assurance program plan documentation and development

**Air Monitoring Technician II - Field Operations - Guy Davis, Susan Determann, Steve Mobley**

Each Air Monitoring Technician II/Field Operations is involved in the ongoing monitoring activities conducted by the District and is responsible for carrying out the following activities:

- operates, calibrates, installs, maintains and repairs air monitoring, meteorological, data acquisition, and particulate sampling, instrumentation
- transports PM filters from laboratory to monitoring stations and back again
- retrieves, and edits (Level I Data Validation) air quality data collected from the operation of the air monitoring equipment
- troubleshoots, repairs, retrofits, modifies and acceptance tests ambient air monitoring, meteorological, data acquisition, particulate sampling, automatic calibration and test instrumentation
- responsible for adhering to the guidelines specified in the Manufacturer's Operation Manuals and the Standard Operating Procedure(s) (SOP) for the monitoring equipment

**Air Monitoring Technician II - Quality Assurance – Scott Weaver**

The Air Monitoring Technician II/Quality Assurance is responsible for conducting system and performance audits for the air quality monitoring program by adhering to U.S. EPA regulations and guidelines and SOPs. Responsibilities include:

- conducting quality assurance performance and system audits for the criteria pollutant program and preparing and issuing appropriate reports and findings
- developing quality assurance SOPs and methodologies
- verifying that all required QA activities are performed as required
- analyzing and evaluating ambient air quality data and making recommendations regarding its quality, accuracy, and validity (Level II Data Validation).

**Air Monitoring Technician II - Laboratory – Valerie Thorp**

The Air Monitoring Technician II/Laboratory is responsible for carrying out required laboratory activities, ensuring the quality of those activities, and adhering to regulatory guidance and protocols specified for lab activities. Those responsibilities include:

- weighing PM filters before and after sampling
- processing filter mass data
- maintaining the laboratory atmospheric conditioning system
- receiving PM filters in the laboratory from the field
- participating in the development and implementation of the QAPP
- participating in the development of data quality requirements (overall and laboratory) with the appropriate QA staff
- writing and modifying SOPs
- verifying that all required laboratory QA activities are performed and that measurement quality standards are met as required
- following all manufacturer's specifications
- performing and documenting preventive maintenance of all laboratory equipment
- documenting deviations from established procedures and methods
- report all problems and corrective actions to management
- assessing and reporting data quality
- preparing and delivering reports to management
- flagging suspect data

**Field Services Technicians I and II – Sondra Grimm, Jamie Johnson, Brian Russell**

The Field Services Technicians I and II assist in the collection of information on the location, frequency, duration, and severity of dust storms from the Owens and Mono Lake playa. The technicians also identifies dust sources using scientific methods and instrumentation such as sand flux monitors, video surveillance devices, air monitoring equipment, observation mapping, and GPS surveying. Specific duties of the field services technicians are as follows:

- install, operate, maintain, and repair air monitoring instrumentation, including weather monitoring stations, particulate monitors, surveillance cameras, network and radio communications systems, and sand flux monitoring stations
- perform routine servicing and preventive maintenance of equipment,
- calibrate air monitoring and meteorological sensors according to regulatory specifications
- troubleshoot and repairs malfunctioning instruments and components
- collect dust storm information and maintains instrumentation; downloads information into the computer system
- use a Geographical Positioning System (GPS) unit to conduct land surveys and produce maps of recently active dust source areas
- conduct visual surveys of the lakebed to determine the extent and recentness of Aeolian surface damage requiring knowledge of sedimentary structures such as wind-formed ripple marks of erosion and deposition accomplished by the wind.

**Data Processing - Senior Research & Systems Analyst – Phill Kiddoo**
**Research & Systems Analyst II - Mike Slates**
**Research & Systems Analyst II – Chris Howard**

The Senior Research & Systems Analyst oversees all of the data processing activities of the District. The data processing personnel are responsible for coordinating the information management activities of the District's air quality monitoring program, which includes the PM10 Ambient Air Monitoring and Dust ID Programs. Specific responsibilities include:

- ensuring that data and information collected for the monitoring programs are properly captured, stored, and transmitted for use by program participants
- developing local data management standard operating procedures
- ensuring that information management activities are developed within reasonable time frames for review and approval
- following good automated data processes
- coordinating the development of the information management system with data users
- ensuring the development of data standards for data structure, entry , transfer, and archive
- ensuring adherence to the QAPP where applicable
- ensuring access to data for timely reporting and interpretation processes
- ensuring timely delivery of all required data to the U.S. EPA's AQS system

These are the roles and responsibilities for the personnel involved in the monitoring, data collection, and analysis activities for the District's PM10, meteorological, and sand flux monitoring programs.

## 5.0 Problem Definition/Background

## 5.1 Problem Statement and Background

Between the years 1900 and 1970, the emission of six principal ambient air pollutants increased significantly. The principal pollutants, also called criteria pollutants, are: particulate matter (PM10, PM2.5), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. In 1969, the first State Ambient Air Quality Standards were promulgated by California for total suspended particulates, photochemical oxidants, sulfur dioxide, nitrogen dioxide, and carbon monoxide. In 1970, the Federal Clean Air Act (CAA) was signed into law. The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. This framework provides for the monitoring of these criteria pollutants by State and local organizations through the Air Quality Monitoring Program.

The criteria pollutant defined as particulate matter is a general term used to describe a broad class of substances that exist as liquid or solid particles over a wide range of sizes. As part of the Ambient Air Quality Monitoring Program, U.S. EPA measures two particle size fractions; those less than or equal to 10 micrometers aerodynamic diameter (PM10), and those less than or equal to 2.5 micrometers aerodynamic diameter (PM2.5). This QAPP focuses on the QA activities associated with PM10. For documentation of activities relating to PM2.5, please see the District's, Quality Assurance Project Plan for the PM2.5 Ambient Air Monitoring Program at State and Local Air Monitoring Stations, March 2001.

The general background and rationale for the implementation of the PM10 ambient air monitoring network can be found in the Federal Register. Some of the findings are listed below.

The characteristics, sources, and potential health effects of larger or "coarse" particles (from 2.5 to 10 micrometers (µm) in diameter) and smaller or “fine" particles (smaller than 2.5 µm in diameter) are very different.

- Coarse particles come from sources such as windblown dust from the desert or agricultural fields and dust kicked up on unpaved roads from vehicle traffic.

- Fine particles are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds that are emitted from combustion activities and then become particles as a result of chemical transformations in the air.

- Coarse particles can deposit in the respiratory system and contribute to health effects such as aggravation of asthma. U.S. EPA's "staff paper" concludes that fine particles, which also deposit deeply in the lungs, are more likely than coarse particles to contribute to the health effects (e.g., premature mortality and hospital admissions) found in a number of recently published community epidemiological studies. Although some studies find that adverse health effects are more strongly associated with high PM10 levels and the coarse fraction.

- These recent community studies find that adverse public health effects are associated with exposure to particles at levels well below the current PM standards for both short-term (e.g., less than 1 day to up to 5 days) and long-term (generally a year to several years) periods.

- These health effects include premature death and increased hospital admissions and emergency room visits (primarily among the elderly and individuals with cardiopulmonary disease); increased respiratory symptoms and disease (among children and individuals with cardiopulmonary disease such as asthma); decreased lung function (particularly in children and individuals with asthma); and alterations in lung tissue and structure and in respiratory tract defense mechanisms.

Air quality samples are generally collected for one or more of the following purposes:

1. To judge compliance with and/or progress made towards meeting the National Ambient Air Quality Standards and the California Ambient Air Quality Standards,
2. To develop, modify or activate control strategies that prevent or alleviate air pollution episodes,
3. To observe pollution trends throughout the region, including non-urban areas,
4. To provide a data base for research and evaluation of effects.
5. To call health advisories and to initiate supplemental control requirements such as "no-burn days."

With the end use of the air quality samples as a prime consideration, various networks can be designed to meet one of six basic monitoring objectives listed below:

- Determine the highest concentrations to occur in the area covered by the network
- Determine representative concentrations in areas of high population density
- Determine the impact on ambient pollution levels of significant source or source categories
- Determine general background concentration levels
- Determine the extent of Regional pollutant transport among populated areas, and in support of secondary standards
- Determine the welfare-related impacts

The monitoring network consists of four major categories of monitoring stations that measure the criteria pollutants, including PM10 and PM2.5. These stations are described below.

The **SLAMS** consist of a network of ~ 3,500 monitoring stations whose size and distribution is largely determined by the needs of State and local air pollution control agencies to meet their respective SIP requirements. There are approximately 250 SLAMS PM10 sites in California.

The National Air Monitoring Stations (**NAMS)** (~1,080 stations) are a subset of the SLAMS network with emphasis being given to urban and multi-source areas. In effect, they are key sites under SLAMS, with emphasis on areas of maximum concentrations and high population density.

The Photochemical Assessment Monitoring Stations (**PAMS**) network is required to measure ozone precursors in each ozone non-attainment area that is designated serious, severe, or extreme. The required networks will have from two to five sites, depending on the population of the area. There is a phase-in period of one site per year starting in 1994. The ultimate PAMS network could exceed 90 sites at the end of the five-year phase-in period

**Special Purpose Monitoring Stations** (SPMS) provide for special studies needed by the State and local agencies to support their SIPs and other air program activities. The SPMS are not permanently established and, thus, can be adjusted to accommodate changing needs and priorities. The SPMS are used to supplement the fixed monitoring network as circumstances require and resources permit. If the data from SPMS are used for SIP purposes, they must meet all QA and methodology requirements for SLAMS monitoring.

***This QAPP focuses on the QA activities of the SLAMS and SPMS network and the objectives of this network, which include any monitor used for comparison to the National Ambient Air Quality Standards (NAAQS).***

Throughout this document, the term *decision maker* will be used. This term represents individuals that are the ultimate users of ambient air data and therefore may be responsible for activities such as setting and making comparisons to the NAAQS, and evaluating trends. Since there is more than one objective for this data, and more than one decision maker, the quality of the data (see Element 7) will be based on the highest priority objective, which was identified as the determination of violations of the NAAQS. This QAPP describes how the District intends to control and evaluate the quality of the PM10, meteorological, and sand flux measurements to meet this high-priority data quality objective.

## 5.2 Specific PM10 Issues in the Great Basin

The National Ambient Air Quality Standard (NAAQS) for PM10 has been violated in three air basins and one town within the District sufficiently for all four areas to be designated as nonattainment for PM10: the Mono Basin, the Town of Mammoth Lakes, the Owens Valley, and the Coso Junction Planning Area. In each of these four areas, State Implementation Plans (SIPs) are in place and PM10 monitoring continues in order to measure progress toward and/or compliance with the Federal and State standards.

The PM10 problem in the Mono Basin, the Owens Valley Planning Area (OVPA), and the Coso Junction Planning Area is associated with wind blown dust resulting from the exposed saline lakebeds and other exposed playa areas. These areas were exposed due to falling lake levels that result from the water-gathering activities conducted by the City of Los Angeles. In all three areas PM10, meteorological, and sand flux monitoring is conducted.

The PM10 problem in the Town of Mammoth Lakes occurs seasonally and is a result of the combination of alpine community meteorology, including low wind speeds and minimal atmospheric mixing, wood smoke associated with dwelling heating, and entrained dust from the application of cinders to ice-and-snow-covered roads to improve traction.

## 5.3 Dust Identification Program

In addition to PM10 monitoring, the District conducts sand-motion monitoring on the exposed emissive lakebeds of the Owens and Mono Lakes and on other exposed playa areas in the District. This monitoring program, known as the Dust Identification Program, involves the use of sand motion monitoring devices (Sensits and sand catchers) the data from which are used, in conjunction with the PM10 and meteorological monitoring data, to characterize and define the sources of the dust emissions from specific areas. Using PM10, sand motion, video, and meteorological data together enables District staff to narrow down the emissive areas requiring mitigation in order to minimize cost while still ensuring the PM standards are met. The Dust ID program formed the basis of a method that was developed to quantify PM10 emissions due to windblown dust. A detailed description of this method has been posted by the EPA as Other Test Method 30 (OTM-30) on their website at, http://www.epa.gov/ttn/emc/prelim.html, and is included in Appendix G of this document.

## 6.0 Project/Task Description

## 6.1 Description of Work Performed

### 6.1.1 PM10 Monitoring

In general, the measurement goal of the PM10 Ambient Air Quality Monitoring Program is to determine the concentration, in units of micrograms per cubic meter μg/m$^3$ ), of particulates less than or equal to 10 micrometers (μm) aerodynamic diameter that have been either collected on a filter or measured by an equivalent method. For the SLAMS/NCore network, the primary goal is to compare the measured PM10 concentrations to the 24-hour National Ambient Air Quality Standard (NAAQS) for PM10. The national primary ambient air quality standard for PM10 is 150μg/m$^3$ for a 24-hour average concentration measured in ambient air. A description of the PM10 NAAQS and the corresponding calculation can be found in Title 40 of the Code of Federal Regulations (CFR), Part 50, Appendix K. In addition, 40 CFR Part 50 Appendix J, Section 2.1, also provides the following summary of the filter-based federal reference method measurement principle:

> " An air sampler draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM10 size range. Each size fraction in the PM10 size range is then collected on a separate filter over the specified sampling period. The particle size discrimination characteristics (sampling effectiveness and 50% cutpoint) of the sampler inlet are prescribed as performance specifications in 40 CFR Part 53 of this chapter.
>
> Each filter is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM10. The total volume of air sampled, corrected to EPA reference conditions (25°C, 101.3 kPa), is determined from the measured flow rate and the sampling time. The mass concentration of PM10 in the ambient air is computed as the total mass of collected particles in the PM10 size range divided by the volume of air sampled, and is expressed in micrograms per standard cubic meter (μg/std m$^3$). For $PM_{10}$ samples collected at temperatures and pressures significantly different from EPA reference conditions, these corrected concentrations sometimes differ substantially from actual concentrations (in micrograms per actual cubic meter), particularly at high elevations. Although not required, the actual $PM_{10}$ concentration can be calculated from the corrected concentration, using the average ambient temperature and barometric pressure during the sampling period."

PM10 measurements are made with EPA-reference method filter-based monitors and continuous equivalent method monitors (Tapered Element Oscillating Microbalance or TEOMs) which have been certified according the tests described in 40 CFR Part 53.34. The following sections will describe the measurements required for the routine field and laboratory activities for the network as well as those measurements necessary to fulfill the requirements of the EPA Air Quality System (AQS) database.

### 6.1.2 Meteorological Monitoring

The goal of the meteorological monitoring program is to support the measurement goals of the PM10 monitoring program. The meteorological monitoring data is put into the

District's model along with the PM10 and sand flux data in order to determine the potential sources of the PM10 being monitored. The meteorological data can be used to screen the PM10 and sand flux data to ensure that only those areas producing PM10 emissions are subject to mitigation.

### 6.1.3 Sand Flux Monitoring

The purpose of the sand flux monitoring program is to quantify PM emissions from open areas susceptible to wind erosion where saltation flux can be measured (Ref. 6). Data collected from the sand flux monitors are collected and put into a model along with the associated meteorological and PM10 monitoring data in order to determine the dust emissions from a given area in terms of area size and quantity of material emitted.

## 6.2 Field Activities – PM10 Monitoring

The performance requirements of the PM2.5 measurement method monitors have been specified in 40 CFR Part 50, Appendix L of the 7/18/97 Federal Register Notice[1]. The District utilizes these monitors configured for PM10 monitoring. Table 6.1 summarizes some of the more critical performance requirements for the monitors as configured for PM10.

**Table 6.1 Design/Performance Specifications**

| Equipment | Acceptance Criteria | Reference |
|---|---|---|
| **Filter Design Specs.** | see reference | 40 CFR Pt. 50, App.L: |
| Size | 46.2mm dia.±0.25 mm | Sec 6.1 |
| Medium | PTFE Teflon with support ring | Sec 6.2 |
| Pore size | 2µm | Sec 6.4 |
| Collection efficiency | >99.7% | Secs. 6.8 |
| Filter Weight Stability | ±20 $\mu g/m^3$ | Sec. 6.9 |
| Alkalinity | <25microequivalnts/gm | Sec. 6.10 |
| **Sampler Performance Specs.** | | |
| Sampling Effectiveness: | | |
| Liquid Particles | ± 10% of predicted ideal | 40 CFR Part53.40, |
| Solid Particles | ≤ ± 5% > liquid particles | Table D-1 |
| 50% Cutpoint | 10.0 ± 0.5 µm aero. dia. | Table D-1 |
| Precision | 5 $^{\mu g/m3}$ or ± 7% for three | Table D-1 |
| | collocated monitors | Table D-1 |
| Flow Rate Stability | Avg flow within ± 5% of initial in 24 hrs, | Table D-1 |
| | All flow rates measured over 24 hours w/in 10% of initial flow rate | Table D-1 |
| Accuracy | Sampler and Audit flow rate within ± 7% and Sampler flow rate within ± 10% of inlet design flow rate | EPA QA Handbook, Vol. II, App. D |

The PM10 monitors deployed throughout the District are certified by the U.S. EPA as meeting the requirements specified in the Federal Register as either reference or equivalent method PM10 monitors. Other than the required federal reference or equivalent air sampler, there are no special personnel or equipment requirements. Element 15 of the QAPP lists all the equipment requirements for the District PM10, meteorological, and sand flux data collection operations.

### 6.2.1 Field Measurements

Table 6.2 represents the field measurements that must be collected by the monitor along with the sample data. This information is presented in Title 40 CFR Part 50 Appendix L, for PM2.5 monitoring. In most cases, these measurements are made by the air sampler and are stored in the instrument for downloading by the field operator during routine visits.

**Table 6.2 Field Measurement Requirements – Filter-based PM2.5 Monitor Configured for PM10 Monitoring**

| Information to be provided | Appendix L section reference | Availability | | | | Format | |
|---|---|---|---|---|---|---|---|
| | | Any-time[a] | End of period b | Visual display c | Data output d | Digital reading[e] | Units |
| Flow rate | 7.4.5 | -- | — | -- | * | XX.X | L/min |
| Flow rate, average for the sample period | 7.4.5 | * | _ | * | * | XX.X | L/min |
| Flow rate, CV, for the sample period | 7.4.5 | * | _ | * | * | XX.X | % |
| Flow rate, 5-min average out of spec. (FLAG)[f] | 7.4.5 | * | * | * | * | On/Off | |
| Sample volume, total | 7.4.5 | * | _ | * | * | XX.X | $m^3$ |
| Temperature, ambient, 30-second interval | 7.4.8 | * | * | * | * | XX.X | °C |
| Temperature, ambient, min., max., average for the sample period | 7.4.8 | * | _ | * | * | XX.X | °C |
| Barometric pressure, ambient, 30-second interval | 7.4.9 | * | * | * | * | XXX | mm Hg |
| Barometric pressure, ambient, min., max., average for the sample period | 7.4.9 | * | _ | * | * | XXX | mm Hg |
| Filter temperature, 30-second interval | 7.4.11 | * | * | * | * | XX.X | °C |
| Filter temperature, differential, 30-minute interval, out of spec. (FLAG)[f] | 7.4.11 | * | * | * | * | On/Off | |
| Filter temperature, maximum differential from ambient, date, time of occurrence | 7.4.11 | * | * | * | * | X.X, YY/MM/DD HH:mm | °C, Yr/Mo/ Day Hr min |
| Date and time | 7.4.12 | * | — | * | * | YY/MM/DD HH:mm | Yr/Mo/ Day Hr min |
| Sample start and stop time settings | 7.4.12 | _ | _ | _ | * | YY/MM/DD HH:mm | Yr/Mo/ Day Hr min |
| Sample period start time | 7.4.12 | — | _ | _ | * | YYYY/MMM/DD HH:mm | Yr/Mo/ Day Hr min |
| Elapsed sample time | 7.4.13 | * | _ | _ | * | HH:mm | Hr min |
| Elapsed sample time out of spec. (FLAG)[f] | 7.4.13 | * | _ | * | * | On/Off | |
| Power interruptions >1 min, start time of first 10 | 7.4.15 | * | _ | * | * | 1HH:mm, 2HH:mm, etc. | Hr min |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| User-entered information, such as sampler and site identification | 7.4.16 | * | _ | * | * | As entered | |

-     Provision of this information is required.

*     Provision of this information is optional. If information related to the entire sample period is optionally provided prior to the end of the sample period, the value provided should be the value calculated for the portion of the sampler period completed up to the time the information is provided.

•     Indicates that this information is also required to be provided to the AIRS data bank.

a     Information is required to be available to the operator at any time the sampler is operating, whether sampling or not.

b     Information relates to the entire sampler period and must be provided following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.

c     Information is available to the operator visually.

d     Information is available as digital data at the sampler's data output port following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.

e     Digital readings, both visual and data output, shall have no less than the number of significant digits and resolution specified.

f     Flag warnings may be displayed to the operator by a single-flag indicator or each flag may be displayed individually. Only a set (on) flag warning must be indicated; an off (unset) flag may be indicated by the absence of a flag warning. Sampler users should refer to Section 10.12 of Appendix L and, more specifically, to Appendix M regarding the validity of samples for which the sampler provided an associated flag warning.

In addition to the measurements collected in Table 6.2, the following information identified in Table 6.3 will be recorded by some monitors. These parameters are explained in *EPA Quality Assurance Guidance Documents 2.10, 2.11, and 2.12.*[2]

**Table 6.3 Additional Field Measurements – Filter-based PM2.5 Monitor Configured for PM10 Monitoring**

| Parameter | Parameter Code | Frequency | Units | Comment |
|---|---|---|---|---|
| Monitor ID | MONID | Every sample event | see AQS | Unique AQS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields |
| Site Name | SITENAM | Every sample event | AAA... | Unique site name associated with the site |
| Sampler ID | SAMPID | Every sample event | AAXXX | Sampler model number or unique bar code number associated with the model number |
| Filter ID | FID | Every sample event | AXXXXX | Unique filter ID of filter given by the weighing laboratory. |
| Filter Integrity flag | FFIF | Every sample event | | INV-Invalid Sample<br>(No Flag) Valid Sample |
| Site Operator Initial | SOI | Every sample event | AAA | Initials of the site operator setting up the sampling run |
| Site Operator Final | SOF | Every sample event | AAA | Initials of the site operator completing the sampling run |
| Free Form Notes | FFM | As needed | AAA.... | Free form notes about the sampling run |

Note: "AAA" denotes an alphabetic character and "XXX" denotes a numeric character.

### 6.2.2 Laboratory Activities

Laboratory activities for the PM10 program include the following three general phases:

**Pre-Sampling weighing**

- Receiving filters from the U.S. EPA/ARB
- Checking filter integrity
- Conditioning filters
- Weighing filters
- Storing prior to field use
- Packaging filters for field use
- Associated QA/QC activities
- Maintaining analytic and micro- balances at specified environmental conditions
- Equipment maintenance and calibrations

**Shipping/Receiving**

- Shipping filters to/Receiving filters from the field and logging these in
- Storing filters
- Associated QA/QC activities (see Element 12)

**Post-Sampling Weighing**

- Checking filter integrity
- Stabilizing/weighing filters
- Data downloads from field data loggers, e-mail, or data forms completed by operators
- Data entry into District spreadsheet
- Associated QA/QC activities
- Data upload to District server
- Storing filters/archiving

The details for these activities are included in various Elements of this document as well as in *Guidance Documents 2.10, 2.11, and 2.12*[2]. Table 6.4 provides the performance specifications of the laboratory environment and equipment.

**Table 6.4 Laboratory Performance Specifications**

| Equipment | Acceptance Criteria |
|---|---|
| Microbalance | Resolution of 1 µg, repeatability of 1 µg |
| Analytical Balance | Resolution of 0.1 mg, repeatability of ± 0.5 mg |
| Balance environment | Climate-controlled, draft-free room or chamber or equivalent, stable work surface. Mean relative humidity between 20 and 45 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature should be held between 15 and 30 °C, with a variability of not more than ±3°C standard deviation over 24 hours. |
| Mass reference standards, microbalance | Standards up to 200 mg*, individual standard's tolerance less than 25 µg, handle with smooth, nonmetallic forceps |

* For the following reasons, the multipoint calibration for the microbalance for this method will be at zero, 100 and 200 mg: 1) the required sample collection filters weigh between 100 and 200 mg; 2) the anticipated range of sample loadings for the 24-hour sample period is rarely going to be more than a few 100 µg; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, microgram standard check weights are not necessary to ensure data quality, as long as proper weighing procedure precautions are taken for controlling contamination or other sources of mass variation in the procedure (see SOP in Appendix B).

### 6.2.3 Laboratory Measurements

With the exception of the shipping/receiving, which is discussed in detail in Element 12, Table 6.5 lists the parameters that will be required to be recorded for pre and post-sampling weighing laboratory activities.

**Table 6.5 Laboratory Measurements – PM10 Filter Processing**

| Parameter | Frequency | Units | Comments |
|---|---|---|---|
| **Filter Conditioning**[1]<br><br>Start Date | every filter | YY/MM/DD | Date of start of conditioning period |
| Start Time | every filter | XX.XX | Start hour and minute of conditioning |
| Filter Number | every filter | PXXXXX<br>LBXXXXX<br>BXXXXX | Unique filter ID of routine filter, Lab Blank (LB), Field Blank (B) |
| Relative Humidity | continuous | XX% | % relative humidity value for conditioning session based upon readings of continuous data collected by datalogger |
| Temperature | continuous | XX$^{o}$C | temperature value for conditioning session based upon readings of continuous data collected by datalogger |
| End Date | every filter | YY/MM/DD | Date of end of conditioning period |
| End Time | every filter | XX.XX | End hour and minute of conditioning |
| **Presampling Filter Weighing**<br><br>Date | every filter | YY/MM/DD | Date for presampling run of filters that can then be associated with each filter |
| Filter Lot Number | every filter | AAAXXX | Lot number associated with filter |
| Balance Number | every filter | AAXXXXX | Unique balance ID for balance used in pre-weighing |
| Analyst | every filter | AAA | Initials of the technician preweighing filters |
| Relative Humidity | continuous | XX% | %relative humidity value for weighing session based upon readings of continuous data collected by datalogger |
| Temperature | continuous | XX$^{o}$C | temperature value for weighing session based upon readings of continuous data collected by datalogger |
| Filter Number | every filter | PXXXXX<br>LBXXXXX<br>BXXXXX<br>PXXXXXRW | Unique filter ID of routine filter, Lab Blank (LB) Field Blank (FB) Flow Check Filter (FC) and Duplicate Filter Weight (Reweigh, RW) |
| QC Sample Number | every QC check | AXXXXXLB1<br>AXXXXXLB2<br>AXXXXXLB3 | Unique ID for calibration checks and or other types of QC samples used |
| Presampling Mass, 46.2mm dia. filters | every filter | XXX.XXX mg | Mass of the filter in mg. |
| Monitor ID[2] | Every sample | see AQS | Unique AQS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields |
| Free Form Notes | As needed | AAA... | Preweighing Free Form notes |

| | | | |
|---|---|---|---|
| **Postsampling Filter Weighing**<br><br>Date | every filter | YY/MM/DD | Date for postsampling run of filters that can then be associated with each filter |
| Balance Number | every filter | AAXXXX | Unique balance ID for balance used in postweighing |
| Analyst | every filter | AA | Initials of the technician postweighing filters |
| Relative Humidity | continuous | XX% | % relative humidity value for weighing period based upon readings of continuous data collected by datalogger |
| Temperature | continuous | $XX^{o}C$ | temperature value for weighing period based upon readings of continuous data collected by datalogger |
| Filter Number | every filter | PXXXXX<br>PXXXXXLB<br>BXXXXX<br>AXXXXXRW | Unique filter ID of routine filter, Lab Blank (LB) Field Blank (B) and Duplicate Filter Weight (Reweigh, RW) |
| QC Sample Number | every QC check | AXXXXXLB1<br>AXXXXXLB2<br>AXXXXXLB3 | Unique ID for calibration checks and or other types of QC samples used |
| Postsampling Mass, 46.2 mm dia. filters | every filter | XXX.XXX mg | Mass of the filter in mg. |
| Postsampling Mass, 8"x10" filters | every filter | X.XXXX gm | Mass of the filter in grams |
| Net Mass, 46.2 dia. filters | every filter | XXX.XXX mg | Net weight (Postsampling Mass - PreSampling Mass) - in mg of PM2.5 |
| Net Mass, 8"x10" filters | every filter | X.XXXX gm | Net weight (Postsampling Mass - PreSampling Mass) - in grams of PM10 |
| Free Form Notes | as needed | AAA... | Postweighing free form notes |

**Note: For units, "AAA", denotes an alphabetic character and "XXX" denotes a numeric character.**

1 Environmental conditions (relative humidity and temperature) in the laboratory will be continuously recorded. Pre- and postweighing of filters will only occur after compliance with specified environmental limits during filter conditioning and weighing periods is verified.
2 The Monitor ID may be assigned at sampling rather than pre-assigned during presampling weighing.

## 6.3 Field Activities – Meteorological Monitoring

Performance requirements for meteorological sensors are listed in the EPA QA Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements Version 2.0 (Final) EPA-454/B-08-002, March 2008. These requirements are presented in Element 7, and are summarized in Table 6.6. The meteorological sensors deployed throughout the District generally meet the requirements for Prevention of Significant Deterioration sensors, with the exception of the wind speed and wind direction sensors. The District has chosen to utilize wind sensors that have sealed bearings, which raise the starting threshold for the sensors to 1 m/s. These sealed bearings result in a more robust sensor that is able to better withstand the harsh dusty environment encountered on and around the exposed lakebed playa.

**Table 6.6 Meteorological Sensor Design/Performance Specifications**

| Equipment | Performance Criteria | Reference |
|---|---|---|
| **Wind Speed** | see reference | EPA QA Handbook, Vol. IV, App. C |
| Accuracy | 0.2 m/s | same |
| Resolution | 0.25 m/s | same |
| Starting Threshold | 0.5 m/s* | same |
| **Wind Direction** | | EPA QA Handbook, Vol. IV, App. C |
| Accuracy | ±5 degrees | same |
| Resolution | 1.0 degrees | same |
| Starting Threshold | 0.5 m/s* | same |
| **Temperature, Ambient** | | EPA QA Handbook, Vol. IV, App. C |
| Accuracy | 0.5°C | same |
| Resolution | 0.1°C | same |
| **Relative Humidity** | | EPA QA Handbook, Vol. IV, App. C |
| Accuracy | ±7% | same |
| Resolution | 0.5% | same |
| **Barometric Pressure** | | EPA QA Handbook, Vol. IV, App. C |
| Accuracy | ±3hPa | same |
| Resolution | 0.5hPa | same |

* District wind speed and direction sensors have a threshold of 1 m/s due to the use of sealed bearings in a dusty environment.

## 6.4 Field Activities – Sand Flux Monitoring

The sand flux measurements conducted by the District require two instruments to monitor the emissions: 1) a sensor to measure the total sand movement over an area for a given period, and 2) a sensor that measures and time-resolves sand movement. The sensor used by the District to achieve the first measurement is the Cox Sand Catcher. This sensor was designed by Bill Cox after several iterations of sand collection devices were tested. The sensor consists of a buried vertical pipe that has catch tube inside of it with an omni-directional inlet with a 1cm-in-height opening that is centered at 15 cm above the surface being measured. Sample tubes are typically collected once per month and the sand catch within them either weighed onsite or taken to the laboratory for weighing. Wet sand catches are dried prior to weighing. The sensor used by the District to make the second measurement, time-resolving the sand movement, consists of a piezo-electric crystal connected to a 1cm-wide sensor ring around the vertical post of the sensor. The sensor is positioned such that the sensor ring is centered 15 cm above the surface being measured. The sensor used by the District is called a Sensit and is manufactured by the Sensit Company in Portland, North Dakota. The Sensit measures the impact or "ping" (particle count, PC) and the kinetic energy (KE) of the impact from the each sand particle that strikes the sensor ring during a dust event. Data from the Sensit are collected on a datalogger and are downloaded monthly for analysis.

**Table 6.6 Sand Flux Monitoring Sensor Design and Performance Specifications**

| Equipment | Performance Criteria | Reference |
|---|---|---|
| **Cox Sand Catcher (CSC)** | Height to inlet center<br>Sensitivity, 0.1 grams | OTM-30, App. C<br>OTM-30, App. C |
| **Field Balance** | Sensitivity, 1 gram<br>Accuracy, 1 gram | OTM-30, App. C<br>OTM-30, App. C |
| **Lab Balance** | Sensitivity, 0.1 grams<br>Accuracy, 0.1 grams | OTM-30, App. C<br>OTM-30, App. C |
| **Sensit** | Particle Count, responds to tap<br>Kinetic Energy, responds to tap | OTM-30, App. C<br>OTM-30, App. C |

## 6.5 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review (MSR), peer review, inspection, or surveillance. Definitions for each of these activities can be found in the glossary (Appendix A). Element 20 will discuss the details of the District's assessments.

Table 6.7 provides information on the parties implementing the assessments and their frequency.

**Table 6.7 Assessment Schedule**

| Assessment Type | Assessment Agency | Frequency |
|---|---|---|
| System Audit | U.S. EPA Regional Office, and/or ARB's QA Section | 1 every 3 to 5 years, |
| Network Review | U.S. EPA Regional Office, ARB Planning and Technical Support Division, District Staff | every year |
| FRM Performance Evaluation | U.S. EPA Regional Office,<br>ARB QA Section,<br>District Staff | 25% of sites/year/4 times per year,<br>all sites once/year,<br>all sites, once/quarter |
| Data Quality Assessment | ARB'S QA Section, and Planning and Technical Support Division | every year |
| Data Quality Assessment | District's QA auditor, Data Processing Staff | every quarter |

## 6.6 Schedule of Activities

Table 6.8 lists the critical activities required to plan, implement, and assess the PM10 monitoring program.

**Table 6.8 Schedule of Critical PM10 Monitoring Activities**

| Activity | Due Date | Comments |
|---|---|---|
| Network development | Completed, reassessed annually | List of sites and samplers required |
| Sampler order | Completed, upgrade/replace as nec. | Samplers ordered from vendors |
| Laboratory design | Completed | List of laboratory requirements |
| Laboratory procurement | Completed | Purchase all lab and field equipment |
| Personnel requirements | Completed, reassessed annually | Develop, advertise, hire as necessary |
| QAPP development | April 2013, revision | Complete District-specific QAPP |
| Network design assessment, revision | Completed, reassessed annually | Network design reviewed annually |
| Monitoring site selection | Completed, reassessed annually | Establish new sites as necessary |
| Monitoring site installation | As needed, usually in summer | Install new station, sampler(s) |
| Sampler testing | Ongoing | Acceptance test new samplers |
| Field/laboratory training | Ongoing | Field/laboratory training activities and certification |
| Draft QAPP submittal | August 2007 | Draft document submitted to EPA Region IX and ARB |
| Revised QAPP submittal | April 2013 | Revise draft with EPA, ARB comments and submit |
| QAPP Approval | December 2013 (estimated) | Approval by ARB, EPA |
| Routine sampling | Ongoing | Routine monitoring activities |

## 6.7 Project Records

The District will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. Table 6.9 represents the categories and types of records and documents that are applicable to document control for PM10 information. Information on key documents in each category is explained in more detail in Element 9.

**Table 6.9 Critical Documents and Records**

| Categories | Record/Document Types |
|---|---|
| Management and Organization | State Implementation Plan<br>Reporting agency information<br>Organizational structure<br>Personnel qualifications and Training<br>Training Certification<br>Quality management plan<br>Document control plan<br>U.S. EPA Directives<br>Grant allocations<br>Support Contract |
| Site Information | Network description<br>Site characterization file<br>Site maps<br>Site Pictures |
| Environmental Data Operations | QA Project Plans<br>Standard operating procedures (SOPs)<br>Field and laboratory notebooks<br>Sample handling/custody records<br>Inspection/maintenance records |
| Raw Data | Any original data (routine and QC data) including data entry forms |
| Data Reporting | Air quality index report<br>Annual SLAMS air quality information<br>Data/summary reports<br>Journal articles, papers, presentations |
| Data Management | Data algorithms<br>Data management plans/flowcharts<br>PM10, Meteorological, Sand Flux Data<br>Data Management Systems |
| Quality Assurance | Network reviews<br>Control charts<br>Data quality assessments<br>QA reports<br>System audits<br>Response/Corrective action reports<br>Site Audits |

**References**

1. Title 40 Code of Federal Regulations Part 50, Appendix J, Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere, August 7, 1987

2. Title 40 Code of Federal Regulations Part 50, Appendix L, Reference Method for the Determination of Particulate Matter as PM2.5 in the Atmosphere, July 18, 1997, amended April 22, 1999, and Oct. 17, 2006

3. U.S. EPA Quality Assurance Guidance Document 2.10: Monitoring PM10 in Ambient Air Using a Dichotomous Sampler, EPA-600/4-77-027a, September 1997.

4. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II, Quality Assurance Guidance Document 2.11: Monitoring PM10 in Ambient Air Using a High Volume Sampler, September 1997.

5. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II, Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods, November 1998.

6. U.S. EPA Other Test Method 30: Method to Quantify Particulate Matter Emissions from Windblown Dust, June 20, 2012

## 7.0 Quality Objectives and Criteria for Measurement Data

## 7.1 Data Quality Objectives (DQOs)

Data quality objectives (DQOs) are qualitative and quantitative statements derived from the DQO Process that clarify a program's technical and quality objectives, define the appropriate type of data, and specify the tolerable levels of decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. By applying the DQO Process to the development of a quality system for PM10, the District guards against committing resources to data collection efforts that do not contribute to a defensible decision. The DQOs were based on the data requirements of the regulations governing PM10 data collections and processing and on determining the network's viability for adequately characterizing impacts from pollutant sources in the air basins under the District's purview. Regarding the quality of the PM10 measurement system, the objective is to control precision and bias in order to reduce the probability of errors. The District acknowledges these objectives represent the minimum necessary to achieve the project goals of a complete and defensible dataset, and will strive to exceed these minimums.

### 7.1.1 Network Design Criteria DQOs

1. *The DQO is based on the National Ambient Air Quality Standards (NAAQS*).

The PM10 standard is 150 µg/ $m^3$ 24-hour average corrected to standard conditions of 25°C and 1013 hecto-Pascals. The 24-hour average standard is met when the 3-year average of the number of daily PM10 exceedances is less than or equal to one.

2. *The limits on precision are based on the smallest number of sample values in a three-year period.*

Since the requirements allow one-in-six day sampling and a 75% data completeness requirement, the minimum number of values in a three-year period is 137. It can be demonstrated that obtaining more data, either through more frequent sampling or the use of spatial averaging, will lower the risk of attainment/non-attainment decision errors at the same precision and bias acceptance levels.

3. *Network station locations are determined based on source characterization*

Stations located in high-impact areas from sources are considered high-concentration area sites, defined by federal regulation (40CFR Part 58, App. D, Section 4.6) as those sites for which the ambient PM10 data show ambient concentrations exceeding the PM10 NAAQS by 20 percent or more.

4. *Factors determining data quality*

Representativeness, completeness, measurement bias, measurement comparability are all measurement quality objectives used to quantify errors in the data to ensure the data meet the data quality objectives required to comply with the PM10 NAAQS and regulatory guidelines.

## 7.2 Measurement Quality Objectives (MQOs)

Once a DQO is established, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. In order to meet DQOs, guidelines must be put in place to insure the accuracy and proper interpretation of the data collected. Measurement quality objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. Information regarding these objectives and their use can be found in the U.S. EPA's Quality Assurance Handbook, Volume II[2]. The data quality elements presented below are used by the District to comply with the requirements in 40 CFR Part 58, Appendix A:

**Accuracy** - Accuracy has been a term frequently used to represent closeness to "truth" and includes a combination of precision and bias error components. This term has been used throughout 40 CFR and in some of the Elements of this document. Based on District, ARB, and EPA performance audits, PM10 flow rate data shall be within ±7% of the transfer standard value and within ±10% of the design value for filter-based and continuous PM10 monitors used for comparison to the NAAQS for PM10.

**Precision** - a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error. Precision is estimated by various statistical techniques using some derivation of the standard deviation. For ambient particulate concentration measurements, precision shall be expressed in terms of a coefficient of variation (CV). The EPA recommendation for precision for filter-based measurements is a CV≤10% for samples of mass ≥3µg/m$^3$(EPA QA Hndbk V. II, App.D; 40CFR58App. A Sec. 4(c)). These data are aggregated and reported quarterly, annually, and triennially (40 CFR 58, App. A Secs. 4.1, 4.2).

Equation 1

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \cdot 100$$

For each collocated data pair, the relative percent difference, $d_i$, is calculated using the equation above, where $X_i$ is the concentration from the primary sampler and $Y_i$ is the concentration from the collocated monitor.

**Coefficient of Variation** – is a measurement of the variability of the concentrations as measured and compared between the primary and collocated monitors. The upper bound of the CV is calculated as follows:

$$CV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2}{2n(n-1)}} \cdot \sqrt{\frac{n-1}{X^2_{01,n-1}}}$$

Equation 2

where n = the number of valid data pairs being aggregated, and $X^2_{0.1,n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each $d_i$ is calculated from two values with error.

**Bias Estimate** – is a measure of the bias of the data based on the results of the one-point flow rate verifications conducted on automated PM10 monitors. The bias estimate can be calculated using the equation below:

Equation 3
$$d_i = \frac{meas - audit}{audit} \times 100$$

where *meas* is the value indicated by the monitor's flow rate measurement and *audit* is the actual flow rate indicated by the transfer standard flow meter. The absolute flow rate bias upper bound is then calculated using this equation,

Equation 4
$$|AB| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}}$$

where *n* is the number of flow rate checks being aggregated; t0.95, n-1 is the 95th quantile of a t-distribution with n-1 degrees of freedom. The quantity *AB* is the mean of the absolute values of the $d_i$ 's calculated using this equation:

Equation 5
$$AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i|$$

and the quantity *AS* in Equation 4 is the standard deviation of the absolute values of the $d_i$ 's and is calculated using the equation below:

Equation 6
$$AS = \sqrt{\frac{n \cdot \sum_{i=1}^{n} |d_i|^2 - \left(\sum_{i=1}^{n} |d_i|\right)^2}{n(n-1)}}$$

**Representativeness** - a measure of the degree which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Spatial and temporal data representativeness shall be achieved by assuring that criteria are met for station siting as defined in federal regulations, and that air quality measurements and statistics are compiled.

**Detection Limit** - a measure of the capability of an analytical method to distinguish low concentrations of a specific analyte.

**Completeness** - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Data completeness requirements are included in the reference methods (40 CFR 50). In addition, the District shall strive to obtain at least 75% data completeness, while maintaining the precision and accuracy objectives. Data completeness (DC) for a single pollutant at a single site (SS) is defined as:

$$\%DC = \frac{(\text{total number of samples possible}) - (\text{Samples lost to calibration}) - (\text{samples lost to downtime})}{\text{total number of samples possible}} \times 100$$

Data completeness for the reporting organization (RO) for a single pollutant shall be defined as:

$$\%DC_{RO} = \frac{1}{n} \sum_{I=1}^{n} \%DC_{SS\,I}$$

Where n = the number of stations reporting

**Comparability** - a measure of confidence with which one data set can be compared to another. Data comparability shall be achieved through the use of uniform procedures and U.S. EPA designated reference or equivalent methods District-wide.

For each of these attributes, acceptance criteria can be developed. Various parts of Title 40 CFR have identified acceptance criteria for some of these attributes as well as *Guidance Documents 2.10 and 2.11*. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Tables 7.1 through 7.3, and 7.4 list the MQOs for the District's PM10, meteorological, and sand flux monitoring program (EPA QA Handbook, Vol II, App. D, Dec. 2008). More detailed descriptions of these MQO’s and how they will be used to control and assess measurement uncertainty will be described in Elements 14 and 23, as well as in the SOPs (Appendices B and E) of this QAPP.

**$PM_{10}$ Filter Based Dichot STP Conditions Validation Template**

| Criteria | Frequency | Acceptable Range | Information (CFR or Method 2.10) |
|---|---|---|---|
| CRITICAL CRITERIA- $PM_{10}$ Filter Based Dichot | | | |
| **Filter Holding Times** | | | |
| Sample Recovery | all filters | ASAP | Part 50 App J sec 9.16 |
| **Sampling Period** | all filters | 1440 minutes ± 60 minutes midnight to midnight | Part 50 App J sec 7.1.5 |
| **Sampling Instrument** | | | |
| Average Flow Rate | every 24 hours of op | average 16.67 liters/minute | Method 2.10 sec 2.1 |
| **Filter** | | | |
| Visual Defect Check (unexposed) | all filters | see reference | Method 2.10 sec 4.2 |
| Collection efficiency | all filters | 99 % | Part 50, App J sec 7.2.2 |
| Integrity | all filters | ± 5 $\mu g/m^3$ | Part 50, App J sec 7.2.3 |
| Alkalinity | all filters | < 25.0 microequivalents/gram | Part 50, App J sec 7.2.4 |
| Filter Conditioning Environment | | | |
| Equilibration | all filters | 24 hours minimum | Part 50, App.J sec 9.3 |
| Temp. Range | all filters | 15-30° C | Part 50, App.J sec 7.4.1 |
| Temp.Control | all filters | ± 3° C SD* over 24 hr | Part 50, App.J sec 7.4.2 |
| Humidity Range | all filters | 20% - 45% RH | Part 50, App.J sec 7.4.3 |
| Humidity Control | all filters | ± 5% SD* over 24 hr | Part 50, App.J sec 7.4.4 |
| Pre/post Sampling RH | all filters | difference in 24-hr means ≤ ± 5% RH | Part 50, App.L sec 8.3.3 |
| Balance | all filters | located in filter conditioning environment | Part 50, App.L sec 8.3.2 |
| **Verification/Calibration** | | | |
| One-point Flow Rate Verification | 1/4 weeks | ± 7% of transfer standard and 10% from design | Method 2.10 sec Table 3-1 |
| OPERATIONAL EVALUATIONS TABLE $PM_{10}$ Filter Based Dichot | | | |
| **Lab QC Checks** | | | |
| Balance Check | beginning, 10th sample, end | ≤ 4 $\mu$g of true zero<br>≤ 2 $\mu$g of 10 mg check weight | Method 2 .10 sec 4.5 |
| "Standard" filter QC check | 10% | ± 20 $\mu$g change from original value | Method 2.10 sec 4.5<br>From standard non-routine filter |
| "Routine" duplicate weighing | 5-7 per weighing session | ± 20 $\mu$g change from original value | Method 2.10 sec 4.5<br>From routine filter set |
| **Verification/Calibration** | | | |
| System Leak Check | During precalibration check | Vacuum of 10 to 15 in. with decline to 0 >60 seconds | Method 2.10 sec 2.2.1 |
| FR Multi-point Verification/Calibration | 1/yr | ± 2% | Part 50, App.L, sec 9.2 |
| Field Temp M-point Verification | on installation, then 1/yr | ± 2°C | |
| Lab Temperature | 1/6 months | ± 2°C | recommendation |
| Lab Humidity | 1/6 months | ± 2% | recommendation |
| Microbalance Calibration | 1/yr | Manufacturer's specification | |
| **Precision** | | | |

**Table 7.1 PM10 Filter-based Low-Volume Monitor Measurement Quality Objectives, Standard Conditions**

| Criteria | Frequency | Acceptable Range | Information (CFR or Method 2.10) |
|---|---|---|---|
| Collocated Samples | every 12 days for 15% of sites | CV $\leq$ 10% of samples > 3 $\mu g/m^3$ | Part 58 App A sec 3.2.5 |
| **Audits** | | | |
| Filter Weighing | 1/yr | ± 20 $\mu g$ change from original value | Method 2.10 Table 7-1 |
| Balance Audit | 1/yr | Observe weighing technique and check balance with ASTM Class 1 standard | Method 2.10 Table 7-1 section 7.2.2 |
| Semi Annual Flow Rate Audit | 2/yr | ± 4% of audit standard<br>± 5% of design flow rate | Part 58, App A, sec 3.3.3 |
| **Monitor Maintenance** | | | |
| Impactor | 1/3 mo | cleaned/changed | Method 2.10 sec 6.1.2 |
| Inlet/downtube Cleaning | 1/3 mo | cleaned | Method 2.10 sec 6.1.2 |
| Vacuum pump | 1/yr | Replace diaphragm and flapper valves | Method 2.10 sec 6.1.3 |
| Manufacturer-Recommended Maintenance | per manufacturers' SOP | per manufacturers' SOP | |
| **SYSTEMATIC CRITERIA - $PM_{10}$ Filter Based Dichot** | | | |
| **Data Completeness** | quarterly | $\geq$ 75% | Part 50 App. K, sec. 2.3 |
| **Reporting Units** | all filters | $\mu g/m^3$ at standard temperature and pressure (STP) | Part 50 App K |
| **Rounding Convention** | | | |
| 24-hour, 3-year average | quarterly | nearest 10 $\mu g/m^3$ ($\geq$ 5 round up) | Part 50 App K sec 1 |
| **Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards** | | | |
| Flow Rate Transfer Std. | 1/yr | ± 2% of NIST-traceable Std. | Part 50, App.J sec 7.3 |
| Field Thermometer | 1/yr | ± 0.1° C resolution, ± 0.5° C accuracy | |
| Field Barometer | 1/yr | ± 1 mm Hg resolution, ± 5 mm Hg accuracy | |
| Primary Mass Stds. (compare to NIST-traceable standards) | 1/yr | NIST traceable<br>(e.g., ANSI/ASTM Class 1, 1.1 or 2) | Method 2.10 sec 9 |
| **Microbalance** | | | |
| Readability | at purchase | 1 $\mu g$ | Method 2.10 sec 4.4 |
| Repeatability | 1/yr | 1$\mu g$ | Method 2.10 sec 4.4 |
| **Calibration & Check Standards** | | | |
| Flow Rate Transfer Std. | 1/yr | ± 2% of NIST-traceable Std. | Method 2.10 sec 9 |
| **Verification/Calibration** | | | |
| Clock/timer Verification | 4/year | 5 min/mo | recommendation |
| **Precision** | | | |
| Single analyzer | 1/3 mo. | Coefficient of variation (CV) $\leq$ 10% | recommendation |
| Single analyzer | 1/ yr | CV $\leq$ 10% | recommendation |
| Primary Quality Assurance Org. | Annual and 3 year estimates | 90% CL of CV $\leq$ 10% | Part 58, App A, sec 4.3.1 |

**SD= standard deviation CV= coefficient of variation**

**Table 7.1 PM10 Filter-based Low-Volume Monitor Measurement Quality Objectives, Standard Conditions (cont.)**

| Criteria | Frequency | Acceptable Range | Information (CFR or QA Guidance 2.12[18]) |
|---|---|---|---|
| **CRITICAL CRITERIA- $PM_{10}$ Continuous** | | | |
| **Sampling Period** | all filters | 1380-1500 minutes, or value if < 1380 and exceedance of NAAQS [1/] midnight to midnight | 40 CFR Part 50 App. J, Sec 7.1.5 |
| **Sampling Instrument** Average Flow Rate | every 24 hours of operation | Average within $\pm$ 10% of design | recommendation |
| **Verification/Calibration** One-point Flow Rate Verification | 1/mo | ± 5% of transfer standard and 10% from design | 40 CFR Part 58, App. A, Sec 3.2.3 |
| **OPERATIONAL EVALUATIONS TABLE $PM_{10}$ Continuous** | | | |
| **Verification/Calibration** | | | |
| System Leak Check | During pre-calibration check | Instrument dependent | QA Guidance Document 2.12, Sec 6.62 |
| FR Multi-point Verification/Calibration | 1/yr | 3 of 4 cal points within $\pm$ 10% of design | QA Guidance Document 2.12, Sec 6.3.4 |
| **Audits** | | | |
| Quarterly Flow Rate Audit | 1/3 mo | ± 5% of audit standard and ±10% of design value | 40 CFR Part 58, App. A, Sec 3.2.4 |
| **Monitor Maintenance** | | | |
| Inlet/downtube Cleaning | 1/mo. minimum | cleaned | QA Guidance Document 2.12, Sec 9.3 & 9.4 |
| Pump Replacement | 1/18 mos. maximum | Inspected, replaced | per manufacturers' SOP, increase as needed |
| Inline Filter, Inlet Seal Replacement | Inspect 1/mo., Repl. 1/6 mos. | Replace semi-annually (1/6 mos.) | QA Guidance Document 2.12, Sec 9.4, 9.5 & 9.6 |
| Manufacturer-Recommended Maintenance | per manufacturers' SOP, increase as needed | per manufacturers' SOP, increase as needed | |
| **SYSTEMATIC CRITERIA – $PM_{10}$ Continuous** | | | |
| **Data Completeness** | monthly | $\geq$ 90% | 40 CFR Part 50 App. K, Sec. 2.3 |
| **Reporting Units** | Hourly concentrations, $\mu g/m^3$ | $\mu g/m^3$ at standard temperature and pressure (STP) | 40 CFR Part 50 App. K |

**Table 7.2 Continuous PM10 Monitor, Standard Conditions, Measurement Quality Objectives**

| Criteria | Frequency | Acceptable Range | Information (CFR or QA Guidance 2.12[18]) |
|---|---|---|---|
| **Rounding Convention** | | | |
| 24-hour average | daily | nearest 1 μg/m³ (≥ 0.5 round up) | 40 CFR Part 50 App. K sec 1 |
| **Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards** | | | |
| Flow Rate Transfer Std. | 1/yr | ± 2% of NIST-traceable Std. | 40 CFR Part 50, App. J sec 7.3 |
| Field Thermometer | 1/yr | ± 0.1 °C resolution, ± 0.5 °C accuracy | recommendation |
| Field Barometer | 1/yr | ± 1 mm Hg resolution, ± 5 mm Hg accuracy | recommendation |
| **Calibration & Check Standards** | | | |
| Flow Rate Transfer Std. | 1/yr | ± 2% of NIST-traceable Std. | QA Guidance Document 2.12, Sec 6.3.2 |
| **Verification/Calibration** | | | |
| Clock/timer Verification | 4/year | 5 min/mo | recommendation |

**Table 7.2 Continuous PM10 Monitor, Standard Conditions, Measurement Quality Objectives (cont.)**

## CRITICAL CRITERIA TABLE – METEOROLOGICAL MEASUREMENT METHODS

**S - single instrument hourly value, G - group of hourly values from 1 instrument**

| Parameter | Criteria | Acceptable Range | | | | | | | Frequency | Samples Impacted | EPA -454/R-99-005 Feb 2000 | EPA Regulation & Guidance | ADEC AM&QA QAPP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Method | Measurement Method Characteristics | | | | | | | | | | | |
| | | Reporting Units | Range | Accuracy | Resolution | Starting Speed | Distance Constant | Sampling Frequency | Raw Data Collection Frequency | | | | |
| Wind Speed (WS) | Cup, blade, or heated sonic anemometer | m/s | 0.5 m/s – 50 m/s | ± 0.2 m/s | 0.25 m/s | ≤ 0.5 m/s | ≤ 0.5 m @ 1.2 kg/m³ | hourly | 1 minute | All Data | Chapter 2 Sec 1 & 8, Chapter 5 Sec 1 & 2 Chapter 8 Sec 1 | QA Handbook Vol IV Section 0 Tables 0-3, 0-4, 0-5, 0-6 | Section 7 Table A8 |
| Vertical WS (VWS) | | | -25 m/s – +25 m/s | ± 0.2 m/s | 0.1 m/s | ≤ 0.25 m/s | ≤ 0.5 m @ 1.2 kg/m³ | hourly | 1 minute | All Data | | | |
| | | | | | | | Damping Ratio | | | | | | Delay Distance |
| WD (azimuth & elevation | Vane or heated sonic anemometer | Degrees (°) | 1° – 360° or 540° | ± 5 degrees | 1.0 degree | ≤ 0.5 m/s @ 10 degrees | 0.4 to 0.7 @ 1.2 kg/m³ | hourly | 1 minute | All Data | | | ≤ 0.5 m @ 1.2 kg/m³ |
| | | | | | | Time Constant | Spectral Response | | | | | | |
| Ambient Temp | Thermistor 10m – 2m | Degrees Celsius (°C) | -40°C to +40°C | ± 0.5°C | 0.1°C | ≤ 1 minute | | hourly | 1 minute | All Data | Chapter 2 Sec 3 & 8, | | Section 7 Table A8 |
| Vertical Temp Difference (ΔT) | | | -40°C to +40°C | ± 0.1°C | 0.02°C | ≤ 1 minute | | hourly | 1 minute | All Data | Chapter 3 Sec 6 Chapter 5 Sec 1 & 2 Chapter 8 Sec 1 | | |
| Dew Point Temperature | Psychrometer/ Hygrometer % | °C | -40°C to +40°C | ± 1.5°C | 0.1°C | ≤ 30 minutes | | hourly | 1 minute | All Data | Chapter 2 Sec 4 & 8, Chapter 5 Sec 1 & 2 | | |
| Relative Humidity/ | | % | 0 – 100% | ± 7% | 0.5 % | ≤ 30 minutes | | hourly | 1 minute | All Data | | | |
| Barometric Pressure (BP) | Aneroid Barometer | mb | 950 mb to 1050 mb Hg | ± 3 mb Hg (0.3 kPa) | 0.5 mb Hg | | | hourly | 1 minute | All Data | Chapter 2 Sec 6 & 8, Chapter 5 Sec 1 & 2 | | |

**Table 7.3 Meteorological Sensors, Measurement Quality Objectives**

| CRITICAL CRITERIA TABLE – METEOROLOGICAL MEASUREMENT METHODS S - single instrument hourly value, G - group of hourly values from 1 instrument | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Criteria** | **Acceptable Range** | | | | | | | **Frequency** | **Samples Impacted** | **EPA -454/R-99-005 Feb 2000** | **EPA Regulation & Guidance** | **ADEC AM&QA QAPP** |
| Solar Radiation | Pyranometer | Watts/m$^2$ | 0 - 1300 | ± 5% of observed | 10 W/m$^2$ | 5 seconds | 285 nm to 2800 nm | hourly | 1 minute | All Data | Chapter 2 Sec 7 & 8, Chapter 5 Sec 1 & 2 | | |
| Precipitation | Tipping Bucket (with Alter type windscreen & heater) | mm $H_20$ | 0 – 50 mm$H_20$/hr | ± 10% of observed or ± 0.5 | 0.3 mm $H_20$ | | | hourly | 1 minute | All Data | Chapter 2 Sec 5 & 8, Chapter 5 Sec 1 & 2 | | |
| | | | | | | | | | | | | | |
| | **Method** | **Measurement Method Characteristics (continued)** | | | | | | | | | | | |
| | | **Reporting Units** | **Range** | **Accuracy** | **Resolution** | | | **Sampling Frequency** | **Raw Data Collection Frequency** | | | | |
| Vector Data WS | DAS Calculation | m/s | 0 – 50.0 m/s | ± 0.2 m/s | 0.1 m/s | | | hourly | 1 minute | All Data | Chapter 4 Section 6 Chapter 8 | QA Handbook Vol IV Section Tables 0-3, 0-4, 0-5, 0-6 | |
| Vector Data WD | DAS Calculation | Degrees (°) | 0 - 360° | ± 5° | 1.0° | | | hourly | 1 minute | All Data | Chapter 4 Section 6 Chapter 8 | | |
| sigma theta (σθ) | DAS Calculation SD of azimuth angle of WD | Degrees (°) | 0 - 105° | ± 5° | 1.0° | | | hourly | 15 minute | All Data | Chapter 4 Section 6 Chapter 8 | | Section 7 Table A8 |
| sigma phi (σw) | DAS Calculation SD of vertical component of WS | m/s | 0 – 10 m/s | ± 0.2 m/s | 0.1 m/s | | | hourly | 1 minute | All Data | Chapter 4 Section 6 Chapter 8 | | Section 7 Table A8 |
| | | **Radiation Range** | **Flow Rate** | **Radiation Error** | **Type** | **Estimates of Means** | | **Estimates of Variance** | | | | | |
| Motor aspirated temp radiation shield (T, Δ,T RH/Dew Point ) | | -100 to 1300 W/m$^2$ | ≥ 3 m/s | < 0.2°C | | | | | | | Chap 2 Sec 3 & 4 Chapter 8 Sec 1 | | |
| Data Acquisition System (DAS) | | | | | Microprocessor-based digital | 1/min for hourly mean (60 samples/hour) | | 6 samples/minute for hourly variance (360 samples/hour) | | | Chapter 4 Section 6 Chapter 8 | | |
| | **Reporting Intervals** | | | | | | | | | | | | |

**Table 7.3 Meteorological Sensors, Measurement Quality Objectives (cont.)**

| CRITICAL CRITERIA TABLE - - SAND MOTION MEASUREMENT METHODS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | Criteria | Acceptable Range | | | | | | Samples Impacted | 2008 OVP SIP |
| | Method | Measurement Method Characteristics | | | | | | | |
| | | Reporting Units | Range | Sensitivity | Resolution | Sampling Frequency | Raw Data Collection Frequency | | |
| Sensit | Particle Count Average | PC | 2.00E+20 | 1x, 10x | | 2-sec. | 5-min. | All Data | |
| | | PC | 2.00E+20 | 1x, 10x | | 2-sec. | hourly | All Data | |
| | Kinetic Energy | KE | 1.00E+05 | 1x, 10x | | 2-sec. | 5-min. | All Data | |
| | | KE | 1.00E+05 | 1x, 10x | | 2-sec. | hourly | All Data | |
| | height to center of Sensor ring | cm | 15±1cm | 0.1 cm | 0.1 cm | every site visit | every site visit | All Data | |
| | Data logger clock time | minutes | NA | 1 second | 1 second | 2-sec. | every site visit | All Data | |
| | Sampling Period | minutes | NA | 1 second | 1 second | 5±1 min. | every site visit | All Data | |
| Cox Sand Catcher | Mass | grams | 5 kg | 0.1 gms | 0.01 gms | monthly | per wind event | All Data | |
| | Inlet Height | cm | 15±1cm | 0.1 cm | 0.1 cm | every site visit | every site visit | All Data | |
| Field Balance | Mass | grams | 5 kg | 1 gram | 1 gram | every site visit | every site visit | All Data | |
| | Mass Calibration | grams | 5 kg | 1 gram | 1 gram | beginning and end of each mass processing day | beginning and end of each mass processing day | All Data | |
| | Mass Calibration Check | grams | 150 gms | 1 gram | 1 gram | every site visit | every site visit | All Data | |
| Lab Balance | Mass | grams | 5 kg | 0.1 gms | 0.01 gms | every mass processing day | every mass processing day | All Data | |
| | Re-weigh 10% of all sand catch samples | grams | 5kg | 0.1gms | 0.01 gms | every mass processing day | every mass processing day | All Data | |
| | Mass Calibration, Min. 3 points + zero over range of expected sample masses | grams | 5kg | 0.1 gms | 0.01 gms | beginning and end of each mass processing day | beginning and end of each mass processing day | All Data | |

**Table 7.4 Dust ID Sand Motion Monitor Measurement Quality Objectives**

## 8.0 Special Training Requirements

Personnel assigned to the PM10 ambient air monitoring activities will meet the educational, work experience, responsibility, personal attributes, and training requirements for their positions. Documentation of personnel qualifications and training will be maintained in a public portion of personnel files and will be accessible for review during systems audit activities. Records of additional training completed by District technicians will be maintained in those files as well. Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. Training is aimed at increasing the effectiveness of employees and the District. Copies of the job descriptions for each position involved in the PM10 monitoring program at the District are located in Appendix D.

## 8.1 Training: Ambient Air Monitoring and Sand Motion Monitoring

Appropriate training is available to employees supporting the Ambient Air Quality Monitoring and Dust Identification Programs, commensurate with their duties. Such training may consist of classroom lectures, workshops, forums, teleconferences, and on-the-job training.

The District trains supervisors, managers, and field and laboratory staff by several means. Supervisors and managers at the District hold and attend U.S. EPA, ARB, and District meetings to stay informed about new monitoring programs and equipment as they are developed. Air quality monitoring and laboratory staff training for the PM10 program is conducted by sending staff to U.S. EPA, ARB, professional association, and/or equipment manufacturer-sponsored training sessions, meetings, and seminars. Sand motion monitoring training is handled by sending staff to equipment manufacturer-sponsored training sessions, meetings and seminars as well. Hands-on training for both air quality and sand motion monitoring is also provided by experienced District staff to new employees. Elements of theses training sessions may include monitor installation, set-up, operation, calibration, maintenance, repair, and documentation; data logger installation, set-up, programming, and operation; and quality assurance activities associated with the monitoring programs.

District staff has and will participate in U.S. EPA and AWMA sponsored training courses, as they are made available. District staff will attend PM10 ambient air monitoring training courses, workshops, forums, etc., on a continuing basis. In addition, GBUAPCD staff will provide additional training on laboratory and monitor operations as needed. The District sponsored a District-wide two-day quality assurance training workshop in June 2012 on all aspects of monitoring and quality assurance, emphasizing principles of quality assurance and changes in the recently revised EPA Quality Assurance Handbook for Air Pollution Measurement Systems.

## 9.0 Documentation and Records

The following describes the District's document and records procedures for the PM10 Program. In U.S. EPA's QAPP regulation and guidance, U.S. EPA uses the term "reporting package," which is defined as all the information required to support the concentration data reported to U.S. EPA, including all data required to be collected as well as data deemed important by the District under its policies and records management procedures. Table 9.1 identifies these documents and records.

## 9.1 Information Included in the Reporting Package

### 9.1.1 Routine Data Activities

The District has a records management system that allows for the efficient archiving and retrieval of records. The PM10 information, Dust Identification information, and the District-collected meteorological information, are included in this system. Table 9.1 includes the documents and records that are to be filed according to the statute of limitations discussed in Element 9.3.

**Table 9.1 PM10 Reporting Package Information**

| Categories | Record/Document Types |
|---|---|
| Management and Organization | State Implementation Plan<br>Reporting agency information<br>Organizational structure<br>Personnel qualifications and training<br>Quality management plan<br>Document control plan<br>U.S. EPA Directives<br>Grant allocations<br>Support Contract(s) |
| Site Information | Network description<br>Site characterization file<br>Site coordinates and description<br>Site pictures |
| Environmental Data Operations | QA Project Plans<br>Standard operating procedures (SOPs)<br>Field and laboratory notebooks<br>Sample handling/custody records<br>Inspection/Maintenance records |
| Raw Data | All original data (routine and QC data) including data entry forms |
| Data Reporting | Annual SLAMS air quality information<br>Data/summary reports<br>Quarterly QC reports |

| | |
|---|---|
| Data Management | Data algorithms<br>Data management plans/flowcharts<br>PM10 Data<br>Sensit and Sand Catcher Data<br>Meteorological Data<br>Data Management Systems<br>Quarterly QC reports |
| Quality Assurance | Network reviews<br>Data quality assessments<br>Four tier Monthly PM10 Validation Reports<br>System audits<br>Response/Corrective action reports<br>Performance Audits: EPA, ARB, District |

### 9.1.2 Annual Summary Reports Submitted to U.S. EPA

As indicated in 40 CFR Part 58, the GBUAPCD must submit to the U.S. EPA Administrator, through the Region IX Office, an annual summary report of all the ambient air quality monitoring data from all monitoring stations designated as SLAMS. The report is submitted by May 1 of each year for the data collected from January 1 to December 31 of the previous year. The report contains the following information:

**PM10**

**Site and Monitoring Information.**

- City name or nearest population center
- County name
- Street address of site location
- AQS site code
- AQS monitoring method code

**Summary Data**

- First, second, third, and fourth highest daily average PM10 concentrations for each site.
- All daily PM10 values above the level of the 24-hour PM10 NAAQS (150 µg/m$^3$) and the dates of occurrence.
- Sampling schedule used as once every 3 days, every day, etc.
- Number of 24-hour average concentrations in the ranges listed in Table 9.2:

**Table 9.2 PM10 Summary Report Ranges**

| Range | Number of Values |
|---|---|
| ($\mu g/m^3$)<br>150 to 350<br>350 to 420<br>420 to 500 | |

GBUAPCD management certifies that the annual summary is accurate to the best of their knowledge. This certification is based on the various assessments and reports assembled by the organization, in particular, the Annual QA Report discussed in Element 21 that documents the quality of the PM10 data and the effectiveness of the quality system.

## 9.2 Data Reporting Package Format and Documentation Control

Table 9.1 represents the documents and records, at a minimum, that must be retained to back up the reporting package. The details of these various documents and records will be discussed in the appropriate elements of this document.

All raw data required for the calculation of PM10 concentrations, the submission of those concentrations to the AQS database, and QA/QC data that support those concentrations, are collected electronically or on data forms that are included in the field and analytical methods Elements. All hardcopy information is completed in indelible ink. Corrections are made by striking one line through the incorrect entry, initialing this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line.

### 9.2.1 Documentation

The District issues notebooks and blank copies of all applicable forms to each technician for each monitoring station. Individual notebooks are associated with each monitoring station in operation in the PM10 and Dust ID Programs. Although data entry forms are associated with all routine environmental data operations, the notebooks can be used to record additional information about these operations.

**Field Logbooks** - Logbooks are housed within the shelter at each PM10, and/or meteorological monitoring station. Dust ID personnel retain notebooks that cover several sites each. The notebooks contain the appropriate pages for the notation of information that may or may not be included on the data or calibration and maintenance forms. Every station visit is logged with the date and time of the visit and a description of the activities that took place. Copies of the notebook pages are submitted to the data management group by the 15$^{th}$ of each month for the previous month's data.

**Field Log Forms -** The data forms for routine operations, calibration, inspection and maintenance and all applicable SOPs are provided to the station operators. Completed forms are submitted to the District database manager with each month's dataset by the $15^{th}$ of the following month.

**Laboratory Notebooks** - Notebooks are also issued for the laboratory. These notebooks are associated with the PM monitoring program. One notebook is available for general comments/notes; others are associated with: the temperature and humidity recording instruments, the filter-storage freezer, calibration equipment/standards, and the micro- and analytical balances used for the monitoring programs.

**Sample shipping/receipt**- The laboratory packages filter samples for shipping and receives the samples directly. Lab notebooks and filter sample data forms are utilized for sample shipping and receiving information and data are entered into the laboratory PM data spreadsheet. The filter sample data forms are also utilized for the chain-of-custody for all filter samples. Currently, all filter samples are hand-carried to and from the District laboratory.

### 9.2.2 Electronic Data Collection

Certain instruments provide an automated means for collecting information that would otherwise be recorded on data entry forms. The District also utilizes an online database system for the collection of routine instrument maintenance information. The information on these systems and in the database is detailed in Elements 18 and 19 of this document. In order to reduce the potential for data entry errors and facilitate data review and validation, automated or telemetry systems are utilized where appropriate and record the same information that is found on data entry forms. These data are downloaded from the instruments and sent to the District's Bishop office, via e-mail or are downloaded directly by data processing staff for incorporation into the data reporting package.

## 9.3 Data Reporting Package Archiving and Retrieval

In compliance with 40 CFR part 58.16(f), and the District's Document Retention Policy, in general, all the information listed in Table 9.1, as well as the sample filters, are retained for a minimum of five years from the final date in a given dataset, i.e. information and filters for the 2000 monitoring year would be retained at least until January 1, 2006. Sand catches are retained for a period of two years; documentation associated with them for five years. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the retention period, the samples and records are retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular retention period, whichever is later. After the five-year retention period, documents are scanned and retained electronically for an additional 15 years.

## 10.0 Sampling Design

The goal of the PM and sand motion monitoring programs is to provide data that support the District, State, and Federal air quality programs and fulfill requirements of the state implementation plans for those areas under the District's purview. These data include aerosol mass measurements, chemically resolved or speciated data (at the District's NCORE station only), sand motion data, and meteorological data. Mass measurements are used principally for PM10 national ambient air quality standards (NAAQS) comparison purposes in identifying areas that do or do not meet the PM10 NAAQS and in supporting area designations as attainment or nonattainment. These needs include emissions inventory and air quality model evaluation, source attribution analysis, and tracking emission control programs. Sand motion data is used to determine and define dust source areas in need of mitigation in order to meet the PM10 NAAQS in a given area.

The District has developed a PM10 monitoring network to determine the attainment or nonattainment status of each area when compared with the NAAQS for PM10. The District's PM10 network is designed to collect ambient PM10 data as required by Title 40 CFR Parts 50 and 58. The ambient data from this network are being used for designating areas as attainment or nonattainment for the federal PM10 air quality standards, developing control programs, and tracking the progress of these control programs. The network design and sampling schedule were developed using criteria specified in Title 40 CFR Part 58.

The overall District network consists of four sub-networks: Mono Basin, Mammoth Lakes, Owens Valley, and the Coso Junction Management Area, as well as other minor source-specific monitoring sites. The sub-networks are set up to monitor areas that have been determined to be nonattainment for PM10. The minor-source-specific sites are generally short-term stations (less than five years) set up to monitor small sources and may be monitored for meteorology only, depending on the emissions of concern.

The Mono Basin network is currently comprised of two PM10 monitoring stations located in the vicinity of Mono Lake: Mono Shore, which includes a meteorological monitoring station, located on the northeast shore of Mono Lake at the point of maximum source impact; and, Lee Vining, the nearest population center, located southwest of Mono Lake. The Mono Basin source, the exposed playa of Mono Lake, is in the process of being mitigated by allowing the lake to refill with minimal water diversions from the tributaries to it. Monitoring is conducted to determine the progress of that mitigation in reducing ambient PM10 concentrations. The Dust Identification network associated with the Mono Basin consists of 25 sand motion monitoring stations spread over a one-square-mile emissive area located on the northeast shore of Mono Lake.

The Mammoth Lakes monitoring network currently consists of a single monitoring station at which PM10 and meteorological data are collected in the Town of Mammoth Lakes. Data collected from this station are used by the Town to forecast no-burn days for wood stove operators and are used to measure the progress of mitigation measures currently in use in the Town.

The Owens Valley monitoring network in its present form consists of thirteen (13) monitoring stations located around the regulatory shoreline of the Owens Dry Lake, at the population centers located in the vicinity of the Lake, and on the lakebed itself. Stations are located in the communities of Lone Pine, Keeler, and Olancha, and at other high-impact areas along the regulatory shoreline, including Dirty Socks Spring, Shell Cut, and Flat Rock along Highway 190 on the south shore of Owens Lake, Stanley Station along the west shoreline, Mill Site along the east shoreline, Lizard Tail and North Beach along the north shore of the lake, T-7 and T27 on the lakebed, and Coso Junction, approximately 16 miles south of the lake and in the corridor through which lakebed emissions are transported during dust storms. All of these stations collect PM10 and meteorological data. The Dust Identification Network associated with Owens Lake, consists of 180 sand motion monitoring stations and five meteorological monitoring stations located on and around the lakebed.

Element 10.1, below, describes the rationale for the placement of collocated samplers throughout the District's monitoring network.

## 10.1 Rationale for the Placement of Collocated Samplers

In order to estimate the precision and bias of the various PM10 samplers, the U.S. EPA requires that for each method designation within a primary quality assurance organization (PQAO), the PM10 sites must be collocated on the following basis: for a network of 1 to 5 sites, select one (1) site; for 6 to 20 sites, select two (2) sites; for more than 20 sites, select three (3) sites. The District is a part of the California Air Resources Board PQAO, and as such, the District's network is a part of the larger CARB network. The District has deployed thirteen (13) monitoring stations operating continuous PM10 samplers (Table 10.1) in the vicinity of Owens Lake. The District has deployed two (2) monitoring stations operating PM10 samplers in the vicinity of Mono Lake. To satisfy the minimum requirement for collocated samplers in the District, currently one station operates collocated PM10 samplers in the vicinity of Owens Lake.

**Table 10.1 Summary of Filter-Based PM10 Stations Deployed in the Great Basin Unified Air Pollution Control District**

| Monitoring Location | Number of Samplers | | |
|---|---|---|---|
| | Primary | Collocated | Total |
| Owens Lake | 1 | 1 | 2 |
| Mono Lake | 1 | 0 | 1 |
| Mammoth Lakes | 1 | 0 | 1 |
| White Mountain Research Ctr. - NCore | 1 | 0 | 1 |
| Total | 4 | 1 | 5 |

The District selected collocated PM10 sites based on the following criteria listed in order of importance:

- Measured or estimated PM10 concentrations - monitoring sites with high measured PM10 concentrations or high estimated PM10 concentrations were selected for the locations of collocated samplers.

- Geographical representation - the network was designed to ensure geographical representation throughout the District because varying meteorological and air quality conditions may influence the precision and bias of various PM10 samplers.

- Practical considerations - the monitoring sites selected to operate collocated PM10 samplers had to have sufficient platform space to maintain 1-4 meter spacing between primary and collocated samplers, and have adequate power available.

Each collocated sampler must be operated concurrently with its associated primary sampler. The one-in-twelve day sampling schedule was selected, as a minimum, for collocated samplers so that the sampling days are distributed evenly over the year and over the seven days of the week. Those samplers that are "collocated" with a continuous PM10 monitor operate on the one-in-three-day federal sampling schedule.

The adequacy of the PM10 network for the achievement of the monitoring objectives will be reviewed during the annual network review and additional monitoring stations and/or collocated monitors will be added as needed.

## 11.0 Sampling Methods Requirements

### 11.1 Purpose/Background

The PM10 monitoring method provides for measurement of the mass concentration of particulate matter having a nominal aerodynamic diameter of 10 micrometers (PM10) in ambient air over a 24-hour period for purposes of determining whether the primary and secondary national ambient air quality standards (NAAQS) for PM10 specified in 40 CFR Part 50.6 are met. The measurement process is considered to be non-destructive, and the PM10 filter sample obtained from a filter-based monitor can be subjected to subsequent physical or chemical analyses.

The sand flux monitoring method provides for the measurement of mass of sands and soils that are blown across the monitoring devices during wind events. These sand and soil samples collected from the Cox Sand Catchers (CSCs) are usually collected on a monthly frequency during the storm season of October through June, and are correlated with the time-resolved data collected from the Sensits. The sand and soil samples are then subjected to mass analysis.

### 11.2 Sample Preparation and Collection – PM10 Monitoring

Federal reference method (FRM) and Federal equivalent method (FEM) monitors are used for the collection of PM10 concentrations for comparison to the NAAQS. The District network employs four models of the FRM sampler: the Rupprecht & Patashnick (R&P, now Thermo) Model 2000, Model FRM 2000, Model Partisol-Plus 2025, and the BGI Model PQ200; and one model of the FEM monitor, the R&P (now Thermo) TEOM Model 1400a. The R&P/Thermo Models 2000, FRM-2000, and the BGI PQ200 are single-day samplers that meet the FRM designation. The R&P/Thermo Model 2025 Sampler is a sequential multiple-day sampler that meets the FRM designation. The R&P/Thermo TEOM Model 1400a is a continuous PM10 monitor that meets the FEM designation. Each sampler is installed with adherence to procedures, guidance, and requirements detailed in 40 CFR Parts 50[1], 53, and 58[2], U.S. EPA QA Guidance Documents 2:10, 2.11, and 2:12[3], the sampler manufacturers operation manual, the District's Field SOPs, and this QAPP.

#### 11.2.1 PM10 Monitor Set-up

Sample set-up of the FRM samplers in the District network takes place any day after the previous sample has been recovered. For multiple day samplers, 15 sample days and one field blank may be set up when daily or one-in-three-day sampling is required. At collocated sites, the second monitor will be set up generally to run at a sample frequency of one-in-twelve days; however, sample set-up will take place on the same day as the primary sampler. Detailed sample set-up procedures are in Appendix E.

Set-up of the FEM monitors in the District network is conducted on a monthly basis at a minimum. The sample filter is installed on the sintered glass tube in the weighing unit. One sample filter will usually last one month, except during storm periods when a filter can become fully loaded during a single event. FEM monitor sites are visited every business day to verify monitor operation and change sample filters if necessary. The data from the FEM monitors is resolved into hourly and 24-hour PM10 concentrations. Monitor set-up and operation procedures are available in the District's PM10 monitoring methods standard operating procedures found in Appendix E.

### 11.2.2 PM10 Sample Recovery

Sample recovery of any individual filter from the FRM sampler in the District network takes place after the end of the sample period for that filter. For one-in-three or one-in-six day sampling on single day samplers, this operation will normally be performed during the days after a sample is collected and before the next is to run. The next sample filter is generally set-up at the same time the exposed sample filter is being removed. For daily or one-in-three day sampling on multiple-day samplers, filter samples are collected during or immediately after the final sample run. The next samples are set-up on this same day. At collocated sites the sample from the second monitor will be recovered on the same day as the primary sampler. Sample recovery procedures are detailed in the District's PM10 sampling methods in Appendix E.

Sites where multiple-day samplers are employed operating on a daily sampling frequency will require a minimum of two site visits per month for exposed sample recovery and unexposed sample set-up for the next sampling days. Sites that utilize multiple day samplers operating on the one-in-three day sampling schedule will require one site visit per month. For sites that utilize single day samplers with one-in-three or one-in-six-day sampling frequency, a recovery and set-up visit will be required for every sample collected.

## 11.3 Sample Preparation and Collection – Sand Flux Monitoring

The CSC samples are collected on a monthly basis. Numbered sample tubes are transported from the lakebed to the laboratory for mass analysis (weighing). Wet samples are dried completely prior to weighing in a laboratory oven at 80°C. The Sensit data are collected daily via telemetry. These data are correlated with the CSC data and time-resolved into 5-minute and hourly monitoring periods.

## 11.4 Support Facilities for Sampling Methods – PM10 Monitoring

Table 11.1 lists the supplies that are available to PM10 field operators. Support facilities for PM10 sampling include offices, trailers, and vehicles.

**Table 11.1 Support Facility Supplies**

| **Item** | **Minimum Quantity** | **Notes** |
|---|---|---|
| Fuses | 2 | *Of the type specified in the sampler manual* |
| Sampler Operations Manual | 1 per model | |
| PM10 Sampling SOP | 1 | |
| Flow rate verification filter | 2 | *Contained in sampling cassette* |
| Non-Permeable Membrane | 2 | *Contained in sampling cassette* |
| Filter Cassettes | 2 | *For use with flow rate check filter or non-permeable membrane* |
| Filter Magazines | 1 per site | *For multiple day samplers only* |
| Cleaning Wipes | 1 Box per site | *Dust resistant* |
| Data Download Cable | 1 | *Laptop computer or personal digital assistant* |

Since there are other items that the field operator may need during a site visit that are not expected to be at each site, the operator is expected to bring these items with him/her. Table 11.2 details those items each operator is expected to bring with them.

**Table 11.2 Site Dependent Equipment and Consumables**

| Item | Minimum Quantity | Notes |
|---|---|---|
| Tools | 1 box | *screw drivers, wrenches, etc...* |
| PM10 Size-selective Inlet | 1 | *Clean inlet to be swapped for dirty inlet* |
| FRM Filter Cassettes, Magazines | 1 for each sampler, plus field blanks | *Loaded with pre-weighed filter(s)* |
| Transport Container | 2 | *1 for pre-weighed, 1 for sampled filter(s)* |

## 11.5 Support Facilities for Sampling Methods – Sand Flux Monitoring

Table 11.3 lists the supplies that are available to sand flux monitoring field operators. Support facilities for sand flux monitoring include offices, trailers, and vehicles.

**Table 11.3 Support Facility Supplies – Sand Flux Monitoring**

| Item | Minimum Quantity | Notes |
|---|---|---|
| Sample Tubes | 2 per site | *Of the type specified in OTM-30* |
| Sample Tube Transport Container | 1 per field tech | |
| Sand Flux Monitoring SOP | 1 per field tech | |
| Sampler Height Measuring Device | 1 per field tech | *Of the type specified in OTM-30* |
| Electronic or paper sampling forms | 1 per site | *Of the type specified in OTM-30* |

Since there are other items that the field operator may need during a site visit, the operator is expected to bring these items with him/her. Table 11.4 details those items each operator is expected to bring with them.

**Table 11.4 Site Dependent Equipment and Consumables**

| Item | Minimum Quantity | Notes |
|---|---|---|
| Tools | 1 box | *screw drivers, wrenches, etc., plus shovel* |
| Spare CSC Inlet | 3-4 | *To replace damaged inlets as necessary* |
| Miscellaneous CSC components | parts to completely construct 1-2 CSCs | |

## 11.6 Sampling/Measurement System Corrective Action

Corrective action measures in the PM10 Air Quality and Sand Flux Monitoring Networks will be taken to ensure the data quality objectives are attained. There is the potential for many types of problems and resulting corrective actions. Table 11.5 presents selected potential problems and their corresponding corrective actions needed for a well-run PM10 network. Table 11.6 provides the same detail for the sand flux monitoring network.

**Table 11.5 Field Corrective Action – PM10 Monitoring**

| Item | Problem | Action | Notification |
|---|---|---|---|
| Filter Inspection (Unexposed) | Pinhole(s) or torn media | 1) If additional filters have been brought, use one of them. Void filter with pinhole or tear.<br><br>2) Use new field blank filter as sample filter.<br><br>3) Obtain a new filter from lab. | 1) Document on field data sheet.<br><br>2) Document on field data sheet.<br><br>3) Notify Field Manager |
| Filter Inspection (Exposed) | Torn or otherwise suspect particulate by-passing 46.2 mm filter. | 1) Inspect area downstream of where filter rests in sampler and determine whether particulate has been by-passing filter.<br><br>2) Inspect in-line filter before sample pump and determine whether excessive loading has occurred. Replace as necessary. | 1) Document on field data sheet.<br><br>2) Document on field data sheet and in logbook. |
| PM10 Size-selective Inlet | Heavily loaded with coarse particulate as indicated by material accumulation in the impactor | Clean inlet, downtube, or swap out dirty inlet for clean one | Document on field data sheet and in logbook. |
| Sample Flow Rate Verification | Out of Specification (+ 4% of transfer standard and +10% of design flow rate.) | 1) Remove flow rate device, re-connect and repeat flow rate check to confirm problem.<br><br>2) Perform leak test.<br><br>3) Re-calibrate flow rate. | 1) Document on data sheet.<br><br>2) Document on data sheet.<br><br>3) Document on data sheet, notify Field Manager, and flag data since last calibration. |
| Leak Test | Leak outside acceptable tolerance | 1) Remove leak check adaptor, re-connect and repeat leak test to confirm problem.<br><br>2) Inspect all seals and O-rings, replace as necessary and repeat leak test. | 1) Document in logbook.<br><br>2) Document in log book, notify Field Manager, and flag data since last successful leak test. |
| Sample Flow Rate | Consistently low flows documented during sample run | 1) Check programming of sampler flow rate.<br><br>2) Check flow with a flow rate verification filter and determine if actual flow is low.<br><br>3) Inspect in-line filter downstream of 46.2 mm filter location, replace as necessary. | 1) Document in logbook.<br><br>2) Document in logbook.<br><br>3) Document in logbook. |
| Ambient Temperature Verification, and Filter Temperature Verification. | Out of Specification (+ 2°C of standard) | 1) Make certain thermocouples are immersed in same liquid at same point without touching sides or bottom of container.<br><br>2) Use ice bath or warm water bath to check a different temperature. If acceptable, repeat ambient temperature verification. | 1) Document on data sheet.<br><br>2) Document on data sheet. |

| Item | Problem | Action | Notification |
|---|---|---|---|
| | | 3) Connect new thermocouple.<br><br>4) Check ambient temperature with another NIST traceable thermometer. | 3) Document on data sheet. Notify Field Manager.<br><br>4) Document on data sheet. Notify Field Manager. |
| Ambient Pressure Verification | Out of Specification (±10 mm Hg) | 1) Make certain pressure sensors are each exposed to the ambient air and are not in direct sunlight.<br><br>2) Call local Airport or other source of ambient pressure data and compare that pressure to pressure data from monitors sensor. Pressure correction may be required.<br><br>3) Connect new pressure sensor. | 1) Document on data sheet.<br><br>2) Document on data sheet.<br><br>3) Document on data sheet. Notify Field Manager. |
| Elapsed Sample Time | Out of Specification ( 1 min/mo) | Check Programming, Verify Power Outages | Notify Field Manager |
| Elapsed Sample Time | Sample did not run | 1) Check Programming<br><br>2) Try programming sample run to start while operator is at site. Use a flow verification filter. | 1) Document on data sheet. Notify Field Manager<br><br>2) Document in logbook. Notify Field Manager. |
| Power | Power Interruptions | Check Line Voltage | Notify Field Manager |
| Power | LCD panel on, but sample not working. | Check circuit breaker, some samplers have battery back-up for data but will not work without AC power. | Document in log book |
| Data Downloading | Data will not transfer. | Document key information on sample data sheet. Make certain problem is resolved before data is written over in sampler microprocessor. | Notify Field Manager. |

**Table 11.6 Field Corrective Action – Sand Flux Monitoring**

| Item | Problem | Action | Notification |
|---|---|---|---|
| CSC Inlet Inspection | Damaged or broken components | 1) Replace inlet. | 1) Document on field data sheet.<br><br>2) Notify Field Manager |
| CSC Inlet Height Inspection | Height is outside the 15cm±1cm criterion above ground level | Inspect area around sampler, reset height to specification | Document on field data sheet. |
| Sensit sensor ring Height Inspection | Height is outside the 15cm±1cm criterion above ground level | Inspect area around Sensit, reset height to specification | Document on field data sheet. |
| Sensit Sensitivity Verification | Out of Specification<br>No response to manual tap | 1) Check wiring, Repair as necessary. Repeat sensitivity test.<br><br>2) Replace Sensit if sensitivity test fails again | 1) Document on data sheet.<br><br>2) Document on data sheet, notify Field Manager, and flag data since last known measurements. |

### 11.7 Sampling Equipment, Preservation, and Holding Time Requirements

This element details: the requirements to prevent sample contamination, the volume of air to be sampled for PM10 samples, preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

#### 11.7.1 Sample Contamination Prevention

The PM10 network has rigid requirements for preventing sample contamination. Powder-free gloves are worn or clean hands are used while handling filter cassettes. Once the filter cassette is taken outside of the gravimetric laboratory it must never be opened as damage may result to the 46.2 mm Teflon filter. Filter cassettes are to be stored in filter cassette storage containers as provided by the sampler manufacturer during transport to and from the laboratory. After exposure, filters must be transported and stored with the sample side up to prevent sample losses. They are to be transported carefully to prevent any unnecessary jarring that could cause sample loss in the storage container. Once samples have been weighed, and prior to and again after they have been to the field for sampling, they are to be stored with the particulate side up, individually, in petri slides in the laboratory.

Operation of the sand flux monitoring network includes procedures for preventing sample contamination as well. Clean hands are to be used while handling the capped CSC sample tubes. Sample tubes are inspected to determine consistency in color through the sample. Darker portions of the sample may indicate a wet sample that requires drying prior to weighing. If the sample is in clumps as tube is tipped or poured into a weighing container, it is wet and must be dried prior to weighing. Wet samples are removed from their tubes, documented, and placed on an inert tray for drying in a laboratory oven. Once samples have been weighed, they are sealed in zippered plastic bags noted with the collection date and site and are archived in a storage area. Sample tubes are cleaned and prepared for their next use.

#### 11.7.2 PM10 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. The target sample flow rate in the particulate samplers used by the District is 16.67 liters per minute (LPM). The total sample of air collected will be approximately 24 cubic meters for a 24-hour sample. Filter samples are expected to be collected over 24 hours; however, in some cases a shorter sample period may be necessary, not to be less than 23 hours. Since capture of PM10 is predicated upon a design flow rate of 16.67 LPM, deviations of greater than 10% from the design flow rate will enable a shut-off mechanism for the sampler. If a sample period is less than 23 hours or greater than 25 hours on a filter-based sampler, the sample will be flagged.

#### 11.7.3 PM10 Sample Temperature Preservation Requirements

The temperature requirements of the PM10 network are explicitly detailed in 40 CFR Part 50, Appendix M and J[1]. During transport from the gravimetric laboratory to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and in the transport container. Excessive heat must be avoided (e.g., do not leave in direct sunlight or a closed-up car during summer). The filter temperature requirements are detailed in Table 11.4.

**Table 11.4 Filter Temperature Requirements**

| Item | Temperature Requirement | Reference |
|---|---|---|
| Filter temperature control during post-sampling conditioning | Condition at a point from 15 to 30°C with control at ±3°C | 40 CFR Part 50, Appendix J, M, Element 7.4.10 |

**References**

The following documents were utilized in the development of this Element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. October 17, 2006.

2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM10 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58., October 17, 2006.

3. U.S. EPA Quality Assurance Guidance Document 2.10: Monitoring PM10 in Ambient Air Using a Dichotomous Sampler; September 1997.

4. U.S. EPA Quality Assurance Guidance Document 2.11: Monitoring PM10 in Ambient Air Using a High Volume Sampler; September 1997

5. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods; November 1998

6. U.S. EPA Other Test Method 30: Method to Quantify Particulate Matter Emissions from Windblown Dust, June 20, 2012

## 12.0 Sample Custody

Sample custody procedures are followed in order to ensure the careful handling of samples throughout the data collection process and to document each step of that process. The PM10 data are used for comparison to the NAAQS. Additionally, the PM10 data, the meteorological data, and the sand motion monitoring data are used in the analysis to determine dust source areas requiring mitigation as described in EPA's OTM-30. Figures 12.1, 12.2, and 12.3 are examples of chain-of-custody forms that are used to track the stages of filter handling throughout the data collection operation. Definitions of parameters on the forms are explained in Table 12-1. Figure 12.4 is an example of a Cox Sand Catcher/Sensit Field Data Collection form and chain-of-custody. Although entries on these forms are made by hand, the information is entered into a computerized sample tracking system, where an electronic record will be kept (see Element 19). This Element addresses sample custody procedures at the following stages:

- Pre-sampling
- Post-sampling
- Filter/sample receipt
- Filter/sample archival

Please note that some of the summary information for samples collected from the R&P/Thermo Partisol Sequential Sampler is collected from the sampler electronically and sent to the District lab via e-mail or on a flash drive, therefore, this information is not recorded on the Field Form for the sequential sampler. Likewise, sample data gathered from the R&P/Thermo TEOM 1400a monitors is collected from the monitors electronically and returned to the District Bishop office via e-mail or flash drive.

## GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

PARTISOL PM-10 24-HOUR SAMPLE REPORT AND CHAIN-OF-CUSTODY

Filter ID: ______________

Site Name: ______________ Cassette ID: ______________

Site ID: ______________ Run Date: ______________

Sampler ID: ______________ Transport to Field: ______________ / ______________

Initial Date

PRE-SAMPLE INFORMATION

Operator: ______________ Filter Install Date: ______________

Install Time: ______________

Stat (upper left): ______________ Mode (upper right): ______________

Start Date: ______________ Amb Temp: ______________

Sample Start: ______________ Filt Temp: ______________

Stop Date: ______________ Amb Press: ______________

Sample Stop: ______________

POST-SAMPLE INFORMATION

Operator: ______________ Filter Remove Date: ______________

Remove Time: ______________

Stat (upper left): ______________ Rec (upper right): ______________

Set Start: ______________

| | Min | Avg | Max |
|---|---|---|---|
| Amb Temp: | ______ | ______ | ______ |
| Filt Temp: | ______ | ______ | ______ |
| Press: | ______ | ______ | ______ |

Act Start: ______________

Act Stop: ______________

Elapse Time: ______________

Max Temp Diff: ______________ Avg Flow: ______________ CV%: ______________

Max Temp Date/Time: ______________ / ______________ Total Vol: ______________

Oprtr Comments: ______________

Transport from Field: ______________ / ______________

Initial Date

LABORATORY INFORMATION

| | Weight | Duplicate | Date | Analyst |
|---|---|---|---|---|
| Initial: | ______ | ______ | ______ | ______ |
| Final: | ______ | ______ | ______ | ______ |

Comments: ______________

**Figure 12.1 Example of Single-Filter Partisol Field Form and Chain of Custody Record**

**GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT**
BGI PQ200 PM-10 24-HOUR SAMPLE REPORT AND CHAIN-OF-CUSTODY

**Site Name:** Mono Lake Shore / Simis Ranch (circle one) **Site ID:** 901 / 782 (circle one)

Transport to Field: ____________ \ ____________
Initial Date

**Pre-Sample Information**

Operator: ____________ Filter Install Date: ____________
Filter ID: ____________ Start Date: ________ Start Time: ________
Sampler ID: ____________ Stop Date: ________ Stop Time: ________

**Post-Sample Information**

Operator: ____________ Filter Remove Date: ____________
Sampler Flags: ____________
Elapsed Time: ________ Total Vol (m^3): ________

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Max | Min | Avg |
| Actual Start Date: | Start Time: | | Amb Temp ('C): | | | |
| Actual Stop Date: | Stop Time: | | Bar Press (mm Hg): | | | |

Avg Flow (LPM): ________ CV%: ________
Oprtr Comments: ____________

Transport from Field: ____________ \ ____________
Initial Date

**Laboratory Information**

| | Weight | Duplicate | Date | Analyst |
|---|---|---|---|---|
| Initial: | | | | |
| Final: | | | | |

Comments: ____________

**Figure 12.2 Example of Single-Filter BGI Field Form and Chain of Custody Record**

## GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
PM10 SEQUENTIALS CUSTODY REPORT

Site Name: ____________________

Site ID: ____________________

Sampler ID: ____________________

Transport to Field: __________ / __________
Initial Date

**INSTALL**

Operator: ____________

Canister Install Date: ____________

Canister Install Time: ____________

**REMOVE**

Operator: ____________

Canister Remove Date: ____________

Canister Remove Time: ____________

Data Dumped to Disk?: ____________

Install Filt Sequence ↓ / Remove Filt Sequence ↑

| | Filter # | Cassette # | Run Date | Laboratory use only: Confirm Filter Sequence |
|---|---|---|---|---|
| Current Filter in Sampler: | | | | |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |

Operator Comments: ____________________

Transport from Field: __________ / __________
Initial Date

LABORATORY INFORMATION

Lab Prep Date: ____________

Prepared by: ____________

Comments: ____________

Date Rec'd in Lab: ____________

Received by: ____________

Comments: ____________

**Figure 12.3 Example of Sequential-Filter Partisol Field Form and Chain of Custody Record**

CSC Field Form.xls

Technician: Date (mm/dd/yyyy): / /

| Site # | Time PST | Pre-Sensit Height, cm | Sensit Response | Final Sensit Height, cm | Pre-CSC Inlet Height, cm | Field Cal Weight, kg | CSC Full, kg | CSC Tare, kg | Final CSC Height, cm | No VP |
|---|---|---|---|---|---|---|---|---|---|---|
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Marble Rankings: 0=No Crust 1=Complete Damage 2=Indent or Surface Damage 3=No Damage 4=Wet

| Site # | Rank | Surface Description | Comments and Maintenance |
|---|---|---|---|
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| | |
|---|---|
| Delivered By: | Date: |
| Received By: | Date: |

**Figure 12.4 Cox Sand Catcher/Sensit Field Data Form and Chain of Custody Record**

Filter Archiving Tracking Form

| Filter ID | Analysis Date | Archive Date | Box ID/Box # | Archived By: | Comments |
|---|---|---|---|---|---|
| | | | | | |
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**Figure 12.5 Filter Archive Form**

**Table 12-1 Parameter List**

| Parameter | Frequency | Comment |
|---|---|---|
| **Identification** | | |
| Site ID | Every sample | Site identification number of where the sample was collected. |
| Site Name | Every sample | Name of the site where the sample was collected. |
| Filter ID | Every Sample | Unique filter ID of filter given by the weighing laboratory. |
| Cass ID # | Every sample | The filter cassette in which the filter was installed. |
| Sample Date | Every sample | The date on which the atmosphere was sampled through the filter. |
| Sampler Model/ID No. | Every sample | Sampler model number or District property number unique to the sampler. |
| **Sample Summary** | | |
| Elapsed Time | Every sample | The amount of time the filter was sampling the air, in hours, minutes. |
| Start Date/Time | Every sample | The date and time (PST) at which sampling began for this filter. |
| Volume | Every sample | The sample volume in cubic meters for this particular filter |
| Avg. Flow Rate | Every sample | The average flow rate during this sample run, in liters per minute |
| Flow CV | Every sample | The coefficient of variation for the flow rate, in percent, during this run. |
| Local Condition Codes | Every sample | Codes that indicate activities in the vicinity of the sampler that may impact the sample. |
| Amb. Temp., °C | Every sample | The maximum, minimum, and average ambient temperature measured by the sampler during the run. |
| Amb. Pres., mm Hg | Every sample | The maximum, minimum, and average ambient pressure measured by the sampler during the run. |
| Sampler Status Codes | Every sample | Codes that indicate parameters measured during the sample run that are out of specification. |

| | | |
|---|---|---|
| Operator Comments | Every sample | Notes made by the operator concerning issues that may affect the filter or sampler. |
| **Chain of Custody** | | |
| Load in Sampler | Every sample | Date, time, and initials of the technician loading the filter in the sampler. Mode indicated on sampler. |
| Remove from Sampler | Every sample | Date, time, and initials of the technician removing the filter from the sampler after the run. |
| Sent to Lab | Every sample | Date, time, initials of technician taking filter from the site and transporting it to the lab. |
| Received at Lab | Every sample | Date, time, initials of technician taking filter from the transport container and placing it in the laboratory for conditioning |
| **LABORATORY DATA** | | |
| Postweighing by | Every sample | Filter must be weighed as soon as possible after sampling. |
| Tare Weight | Every sample | The mass, duplicate mass if used for QC check, date, and initials of analyst performing initial weighing of filter prior to sampling. |
| Gross Weight | Every sample | The mass, duplicate mass if used for QC check, date, and initials of analyst performing final weighing of filter after sampling. |
| Laboratory Comments | As needed | Comments regarding the filter condition, anomalies, anything that occurred during the final weighing procedure that could affect sample integrity. |

## 12.1 Sample Custody Procedure – PM10

One of the most important features of the PM10 sample custody procedure is the unique filter identification number, illustrated below. The filter ID is an alphanumeric value. The initial alpha value identifies the type of filter as being a PM10 (P) filter. The next seven digits represent a unique number. The filter ID is preprinted on the filter support ring or on the filter itself by the manufacturer, thus, simplifying filter tracking and identification.

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### 12.1.1 Pre-Sampling Custody

The District's laboratory SOPs (Appendix B) define how the filters will be enumerated, conditioned, weighed, placed into the protective shipping container, sealed with tape, and distributed to the site operators. Filters must be stored onsite in their shipping containers prior to sampling to prevent contamination. In preparation for sampling:

- Select the appropriate *24-Hour Sample Report - Field Data Sheet* for the filter(s) to be installed in the sampler.
- Remove the filter(s) from the protective container per SOPs. If possible, briefly examine filter to determine filter integrity has been maintained. Install the filter cassette or magazine in the sampler.
- Record "Load in Sampler" information on the *Chain of Custody* portion of the *Field Data Sheet*.

### 12.1.2 Post Sampling Custody

The field sampling SOPs (Appendix E) specify the techniques for properly collecting and handling the sample filters. Upon visiting the site:

- Select the appropriate *24-Hour Sample Report - Field Data Sheet*.
- Remove filter cassette from the sampler. Briefly examine it to determine appropriate filter integrity flag and place it into the protective container per SOPs.
- Record the *Sample Summary* information from the sampler onto the *Field Data Sheet.*
- Record "Remove from Sampler" information on the *Chain of Custody* portion of the *Field Data Sheet*.
- Place the protective container(s) into the transport container in preparation for shipment.
- Record "Prepared for Shipment" information on the *Chain of Custody* portion of the *Field Data Sheet*.

**Shipping Information**

The site operator will deliver the sample(s) to the laboratory, transporting it in his/her vehicle. Shipping requirements include the following:

- Complete the "Sent to Lab" information in the *Chain of Custody* portion of the *Field Data Sheet*.
- Photocopy the *24-Hour Sample Report - Field Data Sheet* and retain the copy onsite.
- Place the original records in a plastic zip lock bag and include them in the transport containers to be taken to the laboratory.
- Seal all transport containers per SOPs.
- Site operator will transport the container to the laboratory, contacting the laboratory technician upon arrival.

### 12.1.3 Filter/Sample Receipt

Filter samples are transported to the Bishop laboratory by the site operator or their designee and delivered directly to the gravimetric laboratory with the associated field data sheet(s). The operator will notify the laboratory technician that the samples have been delivered.

### 12.1.4 Filter/Sample Archival

Once the gravimetric laboratory receives the filters, information from the field data sheets will be used to log the samples in from the field. The laboratory technician will remove the filters from the transport container, place them in the laboratory for equilibration, and prepare them for post-sampling weighing activities. These activities are included in the analytical SOPs (Element 13). The laboratory technicians will take the filters out of the protective containers and the cassettes and examine them for integrity, which will be marked on the field data sheets. The samples will be stored within the conditioned environment of the gravimetric laboratory.

Upon completion of post-sampling weighing activities, the *Filter Archiving Form* (Figure 12.4) will be used by the laboratory technician(s) to archive the filter. Each filter will be packaged according to the SOPs and stored in a box uniquely identified by Site ID and box number. Samples will be archived in temperature-controlled storage for five years past the date of collection. Prior to disposal, U.S. EPA Region IX will be notified of the District's intent to dispose of the filters.

## 12.2 Sample Custody Procedure – Sand Flux

CSC sample tubes are transported from their respective labs directly to the monitoring locations: Owens Lake sample tubes from the Keeler laboratory to Owens Lake; Mono Lake sample tubes from the Bishop office to Mono Lake. These tubes are marked with their tare weights on the tubes themselves and on the CSC Field Form upon installation at a given site.

At the end of a sampling period, the CSC sample tubes from Owens Lake are transported to the Keeler laboratory in the Keeler office. Sample tubes from Mono Lake are transported to the Bishop office. Some samples are weighed in the field using a field balance. Transported samples are stored until they are weighed. Dry samples are weighed with no further handling. Samples are checked for wetness by observing the color of the sample throughout the clear sample tube. Generally, if the sample is a consistent light color, the sample is dry. If, when the sample is poured into a sample container, it is found to be clumped, the sample is wet and must be dried. Wet samples are dried in a laboratory oven at approximately 90°C and then weighed after they are completely dry.

When the CSC samples have been weighed, they are then stored in zippered plastic bags with their sample designation written on the bag. The sample bags are then stored in archival boxes for a minimum of two years or longer if the samples are part of a litigation challenge.

# 13.0 Analytical Methods Requirements

## 13.1 Purpose/Background

This method provides for gravimetric analysis of filters used in the District's PM10 network. The net weight gain of a sample is calculated by subtracting the initial weight from the final weight. Once calculated, the net weight gain can be used with the total flow passed through a filter to calculate the concentration for comparison to the daily and annual NAAQS. Since the method is non-destructive, and due to possible interest in sample composition, the filters will be archived after final gravimetric analysis has occurred.

Similarly for the Cox Sand Catcher (CSC) samples, gravimetric analysis is conducted on all samples collected in the District's Dust ID networks. Samples are removed from their tubes, weighed, and the net weights are recorded and subsequently correlated with the Sensit kinetic energy ($K_e$) and/or particle count (PC) data. These data are then used to determine source area emissions during high wind events. Specific procedures for the collection and analysis of the CSC sand samples are presented in Appendix F.

## 13.2 Preparation of Samples

Upon delivery of approved 46.2 mm Teflon filters for use in the GBUAPCD network, the receipt is documented and the filters stored in the gravimetric laboratory. Storing filters in the laboratory makes it easier to maximize the amount of time available for conditioning. Upon receipt, cases of filters will be labeled with the date of receipt, opened one at a time and used completely before opening another case. All filters in a lot will be used before a case containing another lot is opened. When more than one case is available to open the "First In - First Out" rule will apply. This means that the first case of filters received is the first case that will be used.

Filters are taken out of the case when there is enough room for more samples in the pre-sampling weighing section of the filter conditioning chamber. Filters will be visually inspected according to the monitoring criteria (as specified in 40 CFR Part 50 App. L, Section 10) to determine compliance. See Appendix B for inspection procedure for new shipments of filters. Filters will then be stored in the filter conditioning chamber within the laboratory. The minimum conditioning period is 24 hours. Filters will not be left out for excessive periods of conditioning to minimize possible contamination.

CSC samples are removed from their sample tubes and put into zippered plastic bags, noted with the site number and dates of the sampling period. Wet samples are dried in a laboratory oven prior to analysis.

## 13.3 Analysis Method

### 13.3.1 Analytical Equipment and Method

The analytical instrument used for gravimetric analysis in the FRM or equivalent PM10 sampler method (gravimetric analysis) is the microbalance for low volume samples. The District uses a *Sartorius M5P* microbalance, which has a readability* of 1 µg and a repeatability* of 1µg (* equipment performance terms used by balance vendors to characterize their equipment for purchase comparison purposes; see also Appendix B). The balance is certified annually by a technician from *Sartorius*, the balance manufacturer.

The gravimetric analysis method (Appendix B) consists of information needed to establish and verify the continued acceptability of the set of primary and secondary mass reference standards, and a new lot of filters, and to establish stable conditions in the weighing room. The three main subparts cover pre-sampling filter weighing (tare weight), post-sampling documentation and inspection, and post-sampling filter weighing (gross weight). The details of the gravimetric analysis method can be found in the GBUAPCD microbalance standard operating procedure (Appendix B).

The gravimetric analysis of the CSC samples is described in Appendix F. A top-loading balance is used for the analysis. The balance is calibrated using NIST-certified weights prior to each weighing session. The balance is certified annually by a technician from Sartorius Corporation.

### 13.3.2 Conditioning and Weighing Room

The primary support facility for the PM10 network is the filter conditioning and weighing room/gravimetric laboratory. Specific requirements for environmental control of the conditioning/weighing room laboratory are detailed in 40 CFR Part 50 Appendices J and M.[1] Additional facility space is dedicated for long term archiving of the filters in a freezer for two years, then in ambient conditions in a temperature-controlled office space. PM2.5 filters are kept in a freezer for all years. PM10 filters are moved when the freezer is full, which is approximately 2 years worth of storage. The gravimetric laboratory is used for both pre-sampling weighing and post-sampling weighing of each PM10 filter sample.

### 13.3.3 Environmental Control

The District's gravimetric laboratory is an environmentally-controlled room with temperature and humidity control. Temperature is controlled at a setpoint of 22°C, within the required range of 15 to 30°C. Humidity is controlled at 35%, within the required 20 - 45% relative humidity range. Temperature and relative humidity are measured and recorded continuously during equilibration. The balance is located on a vibration free marble table and is protected from or located out of the path of any sources of drafts. Filters are conditioned before both the pre- and post-sampling weightings. Filters must be conditioned for at least 24 hours to allow their weights to stabilize before being weighed.

## 13.4 Internal QC and Corrective Action for Measurement System

A QC notebook and a database (with disk backups) are maintained which contain the QC data, including the microbalance calibration and maintenance information, routine internal QC checks of mass reference standards and laboratory and field filter blanks, and external QA audits. These data will duplicate data recorded on laboratory data forms but will consolidate them so that long-term trends can be identified. QC charts for the microbalance are calculated from the QC database. These charts enable the analyst to determine any excess drift that could signal an instrument malfunction.

At the beginning of each weighing day, after the analyst has completed zeroing and calibrating the microbalance and measuring the working standard, four laboratory filter blanks are weighed. After approximately every tenth filter weighing, the analyst will reweigh one working standard. The microbalance is re-zeroed as necessary between each weighing. The working standard and blank measurements are recorded in the laboratory QC notebook or database. If the working standard measurements differ from the certified values or the pre-sampling values by more than 3 µg, the working standard measurements will be repeated. If the blank measurements differ from the pre-sampling values by more than 15 µg, the blank measurements will be repeated. If the two measurements still disagree, the Laboratory Manager will be contacted, who may direct the analyst to (1) reweigh some or all of the previously weighed filters, (2) recertify the working standard against the laboratory primary standard, (3) conduct minor, non-invasive diagnostic and troubleshooting, and/or (4) arrange to have the original vendor or an independent, authorized service technician troubleshoot or repair the microbalance.

Corrective action measures in the PM10 FRM system will be taken to ensure good quality data. Tables 13-1 (organized by laboratory support equipment) and 13-2 (organized by laboratory support activity) list potential problems and corrective actions needed to support a well-run PM10 network. Filter weighing will be delayed until corrective actions are satisfactorily implemented.

**Table 13-1 Potential Problems/Corrective Action for Laboratory Support Equipment**

| System | Item | Problem | Action | Notification |
|---|---|---|---|---|
| Gravimetric Lab | Humidity | Out of Specification | Check HVAC system | Lab Manager |
| Gravimetric Lab | Temperature | Out of Specification | Check HVAC system | Lab Manager |
| Balance | Internal Calibration | Unstable | Redo and check working standards | Lab Manager |
| Balance | Zero | Unstable | Redo and check for drafts, sealed draft guard | Lab Manager |
| Balance | Working Standards | Out of Specification | Check balance with Primary standards | Lab Manager |
| Balance | Filter Weighing | Unstable | Check Lab Blank Filters | Document in Log Book |

**Table 13-2 Filter Preparation and Analysis Checks**

| Activity | Method and frequency | Requirements | Action if the requirements are not met |
|---|---|---|---|
| Microbalance Use | | Resolution of 1µg, repeatability of 1µg | Obtain proper microbalance |
| Control of balance environment | | Climate-controlled, draft-free room or chamber | Modify the environment |

| Activity | Method and frequency | Requirements | Action if the requirements are not met |
|---|---|---|---|
| Use of Mass reference standards | Working standards checked every 3 to 6 months against laboratory primary standards | Standards up to 200 mg, individual standard's tolerance less than 25 µg, handle with smooth, nonmetallic forceps | Obtain proper standards or forceps |
| Filter Handling | Observe handling procedure | Use powder-free gloves or clean hands and smooth forceps.<br><br>Replace Po210 antistatic strips every year | Discard mishandled filter or replace<br><br>Expended strips are returned to the manufacturer for proper disposal |
| Filter integrity check | Visually inspect each filter | No pinholes, separation, chaff, loose material, discoloration, or filter non-uniformity | Discard defective filter |
| Filter Identification | Write filter number on filter handling container, and on laboratory data form in permanent ink | Make sure the numbers are written legibly | Replace label or correct form |
| Pre-sampling filter equilibration | Determine the correct equilibration conditions and period (at least 24 hours) for each new lot of filters. Observe and record the equilibration chamber relative humidity and temperature; enter to lab data form. | Check for stability of laboratory blank filter weights. Weight changes must be <15 µg before and after equilibration. Mean relative humidity between 20 and 45 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature will be held between 15 and 30 °C, with a variability of not more than ±3 °C standard deviation over 24 hours. | Revise equilibration conditions and period. Repeat equilibration |
| Initial filter weighing | Observe all weighing procedures. Perform all QC checks | Neutralize electrostatic charge on filters. Wait long enough so that the balance indicates a stable reading. | Repeat weighing |
| Internal QC | After every tenth filter, reweigh one of the two working standards. Weigh four laboratory filter blanks. Reweigh at least one duplicate filter for every tenth filter(duplicate weighing). | The working standard measurements must agree to within 3 µg of the certified values. The blank and duplicate measurements must agree to within 15 µg. | Flag values for validation activities. |
| Post-sampling inspection, documentation, and verification | Examine the filter and field data sheet for correct and complete entries. If sample was shipped in a cooled container, verify that low temperature was maintained. | No damage to filter. Field data sheet complete. Sampler worked OK. | Notify Lab Manager. Void sample. |
| Post-sampling filter equilibration | Equilibrate filters for at least 24 hours. Must be within ± 5% RH of pre-sampling weighing conditions. | Mean relative humidity between 15 and 45 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature will be held between 15 and 30 °C, with a variability of not more than ±3 °C standard deviation over 24 hours. | Repeat equilibration |

| Activity | Method and frequency | Requirements | Action if the requirements are not met |
|---|---|---|---|
| Post-sampling filter weighing | Observe all weighing procedures. Perform all QC checks. | Neutralize electrostatic charge on filters. Wait 20 seconds after balance indicates a stable reading before recording data. | Repeat weighing |

## 13.5 Filter Sample Contamination Prevention, Preservation, and Holding Time Requirements

This element details the requirements needed to prevent and protect the filter sample from contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

### 13.5.1 Sample Contamination Prevention

The analytical support component of the PM10 network has strict requirements for preventing sample contamination. Filters are equilibrated/conditioned and stored in the same room where they are weighed. Filters are only contacted with the use of smooth non-serrated forceps. Upon determination of its pre-sampling weight, the filter is placed in its cassette and then placed in a protective petri dish. The petri dish is labeled with a uniquely identifying number. The filter is never removed from the filter cassette outside of the weigh room as damage may result to the 46.2 mm Teflon filter. The filter cassettes are never removed from their shipping containers until they are placed in a PM10 sampler.

### 13.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50, Appendix L, Section 7.4. The sample flow rate is 16.67 LPM. The design total sample volume of air from which the particulate is collected will be 24 cubic meters based on a 24-hour sample.

### 13.5.3 Temperature Preservation Requirements

The temperature requirements of the PM10 network are detailed in 40 CFR Part 50, Appendix J, Section 7.4. In the gravimetric laboratory, the filters must be conditioned for a minimum of 24 hours prior to pre-weighing, although, a longer period of conditioning may be required. The gravimetric laboratory temperature must be maintained between 15 and 30°C, with no more than a +/- 3°C standard deviation over the 24-hour period prior to weighing the filters. During transport from the laboratory to the sample location, there are no specific requirements for temperature control; however, the filters are stored in their cassettes in a sealed protective container and excessive heat is avoided. The temperature requirements are detailed in Table 13-3.

**Table 13-3 Temperature Requirements**

| Item | Temperature Requirement | Reference |
|---|---|---|
| Gravimetric Laboratory | 15 - 30°C | 40 CFR Part 50, Appendices J and M, Section 7.4.1 |
| Filter Conditioning, Pre- and Post-exposure | +/- 3°C standard deviation for 24 hours prior to weighing | 40 CFR Part 50, Appendices J and M, Section 7.4.2 |

### 13.5.4 Sample Holding Times

The sample holding times for the PM10 samples are not specified in either 40 CFR Part 50, Appendix J[1] or the U.S. EPA QA Guidance Documents 2.10 or 2.11[2]. The general principle of returning the filters as soon as possible after collection for equilibration and final weighing is adhered to by the District.

**References**

The following documents were utilized in the development of this element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. July 18,1997.

2. U.S. EPA Quality Assurance Guidance Document 2.10: Monitoring PM10 in Ambient Air Using a Dichotomous Sampler. September 1997.

3. U.S. EPA Quality Assurance Guidance Document 2.11: Monitoring PM10 in Ambient Air Using a High Volume Sampler. September 1997.

4. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods; November 1998

5. U.S. EPA Other Test Method 30: Method to Quantify Particulate Matter Emissions from Windblown Dust, June 20, 2012

6. GBUAPCD Standard Operating Procedure for Mass Analysis of Fine Particulate Collected on Teflon Filters, October 2000

## 14.0 Quality Control Requirements

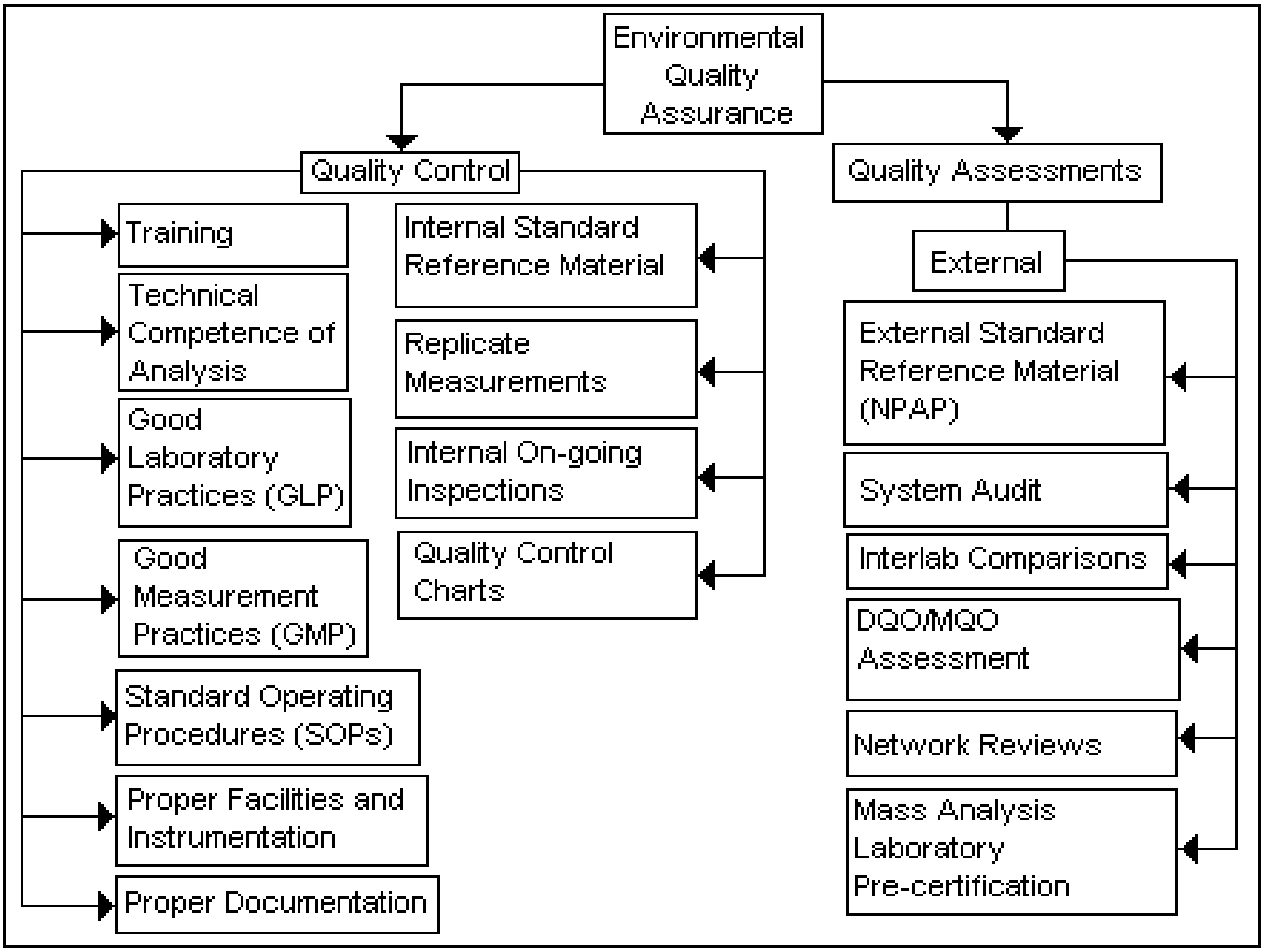


Figure 14.1 Quality control and quality assessment activities

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad quality assurance activities, such as establishing policies and procedures, developing data quality objectives, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data.

Quality control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the District. In the case of the Ambient Air Quality Monitoring Network, QC activities are used to ensure that measurement uncertainty, as discussed in Element 7, is maintained within acceptance criteria for the attainment of the DQO. Figure 14.1 represents a number of QC activities that help to evaluate and control data quality for the PM10 program. Many of the activities in this figure are implemented by the District and are discussed in the appropriate sections of this QAPP. The other activities in this figure are implemented by the California ARB and/or the U.S. EPA.

## 14.1 QC Procedures

Day-to-day quality control is implemented through the use of various check samples or instruments that are used for comparison. The measurement quality objectives tables in Element 7 contain a complete listing of these QC samples as well as other requirements for the PM10 Program (Tables 7-1 through 7-3). The procedures for implementing the QC samples are included in the field and analytical methods (Elements 11 and 13, respectively). As Figure 14.2 illustrates, various types of QC activities have been inserted at phases of the data operation to assess and control measurement uncertainties. Tables 14-1 and 14-2 contain summaries of all the field and laboratory QC activities. The following information provides some additional descriptions of these QC activities, how they will be used in the evaluation process, and what corrective actions will be taken when they do not meet acceptance criteria.

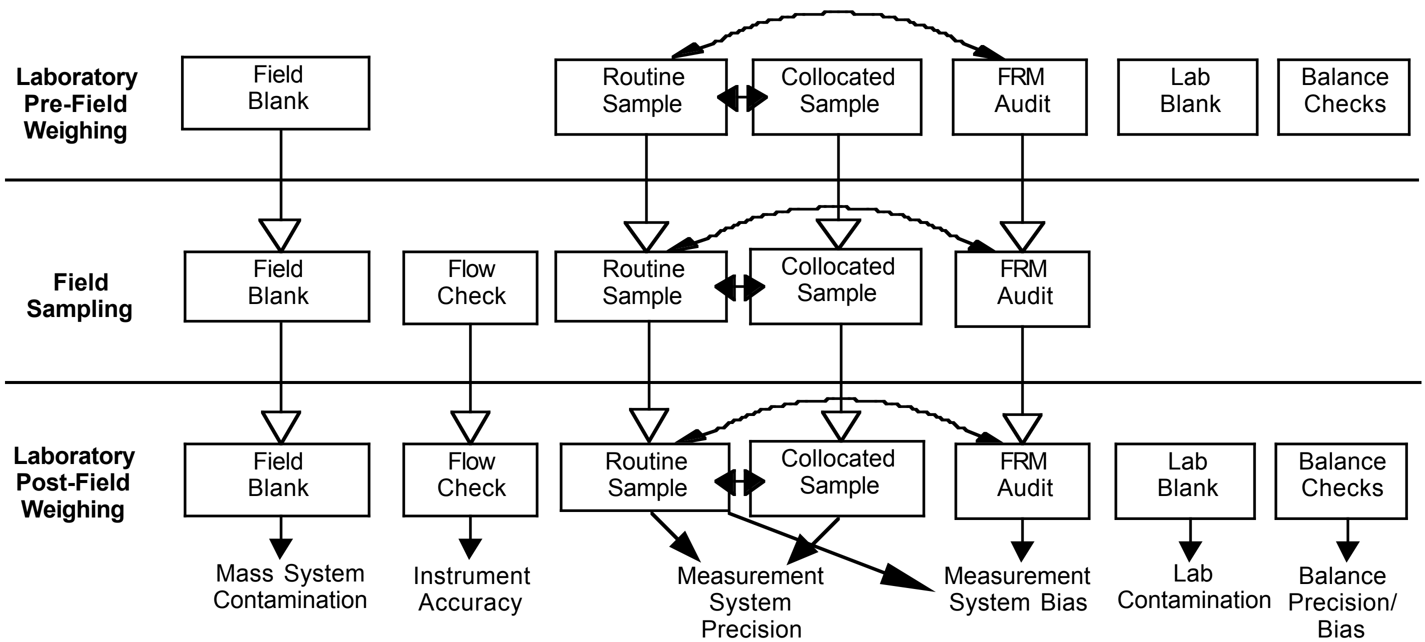


**Figure 14-2 PM10 Quality Control Sampling Scheme, Filter-Based Monitors**

**Table 14-1 Field QC Checks**

| Requirement | Frequency | Acceptance Criteria | CFR Reference | QA Guidance Document Reference | Information Provided |
|---|---|---|---|---|---|
| ***Calibration Standards*** | | | | | |
| Flow Rate Transfer Std. | 1/yr | ±2% of NIST-traceable Std.; | Part 50, App. J, M Sec 7.1.4; | 2.10, Sec. 2.2 | Certification of Traceability |
| Field Thermometer | 1/yr | ± 0.1°C resolution<br>± 0.5°C accuracy; | not described; | 2.10, Sec 3.4.1; 2.12 Sec. 3.3, Table 3-1 | Certification of Traceability |
| Field Barometer | 1/yr | ± 1 mm Hg resolution<br>± 5 mm Hg accuracy | not described | 2.10, Sec. 3.4.1; 2.12 Sec. 3.3, Table 3-1 | Certification of Traceability |
| ***Calibration/Verification*** | | | | | |
| Flow Rate (FR) mult-point verification | 2/yr or if single-point verification failure | ± 7% of transfer standard and ±10% of design FR | not described | 2.10, Table 2-1 | Calibration drift and memory effects |
| Calibration FR single-point verification | 1/month | ± 7% of transfer standard and ±10% of design FR | not described | 2.12 Sec. 3.3, Table 3-1, Sec. 8.4.1 | Calibration drift and memory effects |
| External Leak Check | monthly | <80 mL/min | Part 50, App.L, Sec 7.4.6 | 2.12 Sec. 3.3, Table 3- | Sampler function |
| Internal Leak Check | monthly | <80 mL/min | " | 1; Sec. 8.4.3 | Sampler function |
| Temperature Calibration | monthly | ± 2°C of standard | Part 50, App.L, Sec 9.3 | 2.12, Secs. 6.4, 8.3<br>2.12, Secs. 6.4, 8.3 | Calibration drift and memory effects |
| Temp multi-point verification | If multi-point failure on installation, then 1/yr | ± 2°C of standard | Part 50, App.L, Sec 9.3 | 2.12, Sec. 6.4<br>2.12, Sec. 6.4 and 8.2<br>“ | Calibration drift and memory effects<br>Calibration drift and |
| One- point temp Verification | 1/4 weeks<br>on installation, then | ± 4°C of standard | "Part 50, App.L, Sec 7.4 | 2.12, Sec. 6.5 | memory effects<br>Calibration drift and |
| Pressure Calibration | 1/yr | ±10 mm Hg | “ | | memory effects |
| Pressure Verification | monthly | ±10 mm Hg | “ | 2.12, Sec. 8.2 | Calibration drift and memory effects |
| Clock/timer Verification | monthly | 1 min/mo | “ | not described | Verification to assure proper function |
| ***Blanks*** | | | | | |
| Field Blanks | 10% of monitors sampling frequency | ±30 μg | not described | QA G.D. 2.12, Sec. 7.7 | Measurement system contamination |
| ***Precision Checks*** | | | | | |
| Collocated samples | every 12 days | CV ≤ 20% | Part 58, App.A, Sec 3.3, 5.3 | QA G.D. 2.10, 2.11 Sec. 8.0 | Measurement system precision |
| ***Audits*** (*external assessments*) | | | | | |
| Flow rate audit | 1/yr | ± 7% of audit standard and ±10% of design FR, | Part 58, App A, Sec 3.4.1 | QA G.D. 2.10, 2.11 Sec 7.0, 8.0 | External verification bias/accuracy |
| Temperature Audit | 1/yr | ± 2°C, | not described | QA G.D. 2.10, 2.11 Sec 1.0 | Calibration drift and memory effects, |
| Pressure Audit | 1/yr | ±10 mm Hg | not described | | same as above |

**Table 14-2 Laboratory QC**

| Requirement | Frequency | Acceptance Criteria | CFR Reference | QA Guidance Document Reference | Information Provided |
|---|---|---|---|---|---|
| ***Blanks*** | | | | | |
| Lot Blanks | 3 filters per lot | ±15 µg difference | Part 50, App. L, Sec 8.3 | 2.12 Sec. 7 | Filter stabilization/equilibrium |
| Lab Blanks | 3 per batch | ±15 µg difference | " | 2.12 Sec. 7.7 | Laboratory contamination |
| ***Calibration/Verification*** | | | | | |
| Balance Calibration | 1/yr | Manufacturers spec. | Part 50, App. L, Sec 8.1, | 2.12 sec 7.2, | Verification of equipment operation |
| Lab Temp. Calibration | 1/yr | ± 2°C | Not defined, | QAPP Sec. 13/16, | Verification of equipment operation |
| Lab Humidity Calibration | 1/yr | ±2% | " | QAPP Sec. 13/16 | Verification of equipment operation |
| ***Accuracy*** | | | | | |
| Balance Audit | 1/year | Not defined | Not defined | 2.12 Sec 10.2 | Laboratory technician operation |
| Balance Check | beginning, end of weighing session | Not defined | Part 50, App. L, Sec 8.1 | 2.12 Sec. 7.9 | Balance accuracy/stability |
| ***Calibration standards*** | | | | | |
| Working Mass Stds. | 3-6 mo. | tolerance ≤ 25 µg | Not defined | 2.12 Sec 4.3 and 7.3 | Standards verification |
| Primary Mass Stds. | 1/yr | tolerance ≤ 25 µg | " | " | Primary standards verification |
| ***Precision*** | | | | | |
| Duplicate filter weighings | 1 for every 10 filters | ±20 µg difference | Not defined | 2.10, 2.11 Sec 4.5 QAPP Sec. 13/16 | Weighing repeatability/filter stability |

### 14.1.1 Calibrations

Calibration is the comparison of a measurement standard or instrument with another standard or instrument to report, or eliminate by adjustment, any variation (deviation) in the accuracy of the item being compared[1]. The purpose of calibration is to minimize bias.

For PM10, calibration activities follow a two-step process:

1. Certifying the calibration standard and/or transfer standard against an authoritative standard, and
2. Comparing the calibration standard and or transfer standard against the routine sampling/analytical instruments.

Calibration requirements for the critical field and laboratory equipment are found in Tables 14.1 and 14.2 respectively; the details of the calibration methods are included in the calibration Element (Element 16) and in the field and laboratory methods Elements (11 and 13, respectively).

### 14.1.2 Blanks

Blank samples are used to determine contamination arising from principally four sources: the environment from which the sample was collected/analyzed, the reagents used in the analysis, the apparatus used, and the operator/analyst performing the data operation. Three types of blanks will be implemented in the PM10 Program:

**Lot Blanks** - a shipment of 46.2mm filters will be periodically procured by the District from the US EPA for the PM10 lab. Each shipment must be tested to determine the length of time it takes the filters to stabilize. Upon arrival of each shipment, three lot blanks will be randomly selected from the shipment and be subjected to the conditioning/pre-sampling weighing procedures. The blanks will be weighed daily for a minimum of five days to determine the length of time it takes to maintain a stable weight reading.

**Field Blanks** - provide an estimate of total measurement system contamination. By comparing information from laboratory blanks against the field blanks, one can assess contamination from field activities. Details of the use of the field blanks can be found in field SOPs (Appendix E).

**Lab Blanks** - provide an estimate of contamination occurring at the weighing facility. Details of the use of the lab blanks can be found in the lab SOPs (Appendix B).

**Lab Blank Evaluation**

Three (3) lab blanks will be weighed in each weighing session day. The following statistics will be used for data evaluation purposes:

**Difference for a Single Check *(d)*** - The difference, *d*, for each check is calculated using Equation 1, where *X* represents the weight of the filter measured from its previous weighing and *Y* represents the weight of the filter measured from the current weighing session.

Equation 1

$$d = Y - X$$

**Mean Difference for Batch ($d_z$)** - The mean difference $d_z$ for lab blanks within a weighing session batch is calculated using Equation 2 where $d_1$ through $d_n$ represent individual differences (calculated from Equation 1) and *n* represents the number of blanks in the batch.

Equation 2

$$d_z = \frac{d_1 + d_2 + d_3 \ldots d_n}{n}$$

**Corrective Action**- The acceptance criteria for lab blanks is 15 µg difference as determined by Equation 1. However, the mean difference based upon the number of blanks in each batch will be used for comparison against the acceptance criteria. If the mean difference of the laboratory blanks is greater than 15µg, then the laboratory balance will be checked for proper operation and all the lab blanks in the weighing session will be re-weighed. Prior to re-weighing, the laboratory balance will be checked for proper operation. If the blank mean is still out of the acceptance criteria, all samples within the weighing session will be flagged with the appropriate flag, and efforts will be made to determine the source of contamination. If the mean difference of the laboratory blanks is greater than 20µg and 2 or more of the blanks were greater than 20µg, the laboratory weighing will stop until the issue is satisfactorily resolved. The laboratory analyst will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Lab blanks can be control charted (see Element 14.2) if a problem occurs, as a part of the troubleshooting process. The batch difference calculation (Equation 2) can be used for control charting purposes.

**Field Blank Evaluation**

Field blanks will be weighed in the same weighing session as associated routine samples from the site. The following statistics will be generated for data evaluation purposes:

**Difference for a Single Check *(d)*** - The difference, *d*, for each check is calculated using Equation 3, where *X* represents the original weight of the filter and *Y* represents the filter weight after transport to and from the monitoring site including exposure in the sampler.

Equation 3

$$d = Y - X$$

**Corrective Action**- The acceptance criteria for field blanks is 30 µg difference as determined by Equation 1. If the field blank value is out of the acceptance criteria, efforts will be made to determine the source of contamination. In theory, field blanks should contain more contamination than laboratory blanks. Therefore, if the field blanks are outside of the criteria while the lab blanks are acceptable, weighing can continue on the next batch of samples while field contamination sources are investigated. The laboratory analyst will alert the Laboratory Manager. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Field blanks can be control charted for each monitoring site (see Element 14.2) if a problem occurs, as a part of the troubleshooting process. The difference calculation (Equation 1) can be used for control charting purposes.

### 14.1.3 Precision Checks

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the data quality objectives for precision, the District must ensure the entire measurement process is within statistical control. Two types of precision measurements will be made in the PM10 Program.

- Collocated monitoring
- Filter duplicates

**Collocated Monitoring**

In order to evaluate total measurement precision, collocated monitoring will be implemented, as referenced in 40 CFR Part 58, Appendix A, Section 3.3. Therefore, every method designation will have collocated monitors (1 for 1 to 5 site networks, 2 for 6 to 20 site networks, 3 for networks of more than 20).

These monitors are located at sites that collect the highest 25% of measured concentrations in a given network or sub-network.

**Evaluation of Collocated Data**- Collocated measurement pairs are selected for use in the precision calculations only when both measurements are above 3 μg/m$^3$. However, all collocated data will be reported to AQS.

The following equations will be used to evaluate collocated data. These equations are included in *40 CFR Part 58 Appendix A, Section 4*. The equation numbers in 40 CFR will also be utilized in this QAPP.

**Percent Estimate from Collocated Samplers ($d_i$)** - The percentage difference, $d_i$, for each check is calculated by using Equation 4, where $X_i$ represents the concentration produced from the primary sampler and $Y_i$ represents the concentration reported for the duplicate sampler.

Equation 4

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \cdot 100$$

**Coefficient of Variation (CV) Upper Bound -** The coefficient of variation, *CV*, upper bound is calculated using Equation 5 below, where n is the number of valid data pairs being aggregated, and $X^2_{0.1,n-1}$, is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each $d_i$ is calculated from two values with error.

Equation 5

$$CV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2}{2n(n-1)}} \cdot \sqrt{\frac{n-1}{X^2_{0.1,n-1}}}$$

**Bias Estimate Using One-Point Flow Rate Verifications –** The percent difference in flow rate is calculated for each one-point flow rate verification, using equation 6 below, where *meas* is the value indicated by sampler's flow meter and *audit* is the actual flow rate indicated by the audit flow meter.

$$d_i = \frac{meas - audit}{audit} \times 100$$

Equation 6

This statistic averages the individual biases described in equation 6 above to the desired level of aggregation using equation 7, below:

Equation 7
$$D = \frac{1}{n_j} \cdot \sum_{i=1}^{n_j} d_i$$

where , $n_j$ is the number of pairs and $d_1$, $d_2$, …., $d_{nj}$ are the biases for each of the pairs to be averaged. Confidence intervals can be constructed for these average bias estimates in equation 7 using equations 8 and 9 below:

$$\text{Upper 90\% Confidence Interval} = D + t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}}$$

Equation 8

$$\text{Lower 90\% Confidence Interval} = D - t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}}$$

Equation 9

Where $t_{0.95,df}$ is the 95th quantile of a t-distribution with degrees of freedom df = $n_j$-1 and *s* is an estimate of the variability of the average bias calculated using equation 10 below:

$$s = \sqrt{\frac{\sum_{i=1}^{n_j} (d_i - D)^2}{n_j - 1}}$$

Equation 10

**Corrective Action: Single Monitor -** The precision data quality objective of 20% coefficient of variation (CV) is based upon the evaluation of three years of collocated precision data. The goal is to ensure that precision is maintained at this level. Therefore, precision estimates for a single pair of collocated instruments, or even for a quarter, may be greater than 20% while the three year average is less than or equal to 20%. Therefore, single collocated pairs with values >20% will be flagged and investigated. If the value remains between 20-30% the field technician will be alerted to the problem. If the CV is greater than 30% after investigation, all the primary sampler data will be investigated from the last precision check and corrective action initiated as necessary. Paired CVs and percent differences will be control charted to determine trends if determined to be necessary (Element 14.2). The laboratory technician will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

**Corrective Action: Quarter -** Usually, corrective action will be initiated and imprecision rectified before a quarter's worth of data fail to meet the 20% CV criterion. However in the case where the quarter's CV is greater than 30%, the routine data for that monitor for that quarter will be flagged. The problem and solution will be reported and appropriately filed under response and corrective action reports.

**Duplicate Laboratory Measurements**

During laboratory pre-weighing and post-weighing sessions, a routine filter from the sampling batch will be selected for a second weighing. Equations 1 and 2 will be used to calculate this information. The difference between the two filter weights must be less than 20µg. If this criterion is not met, the pair of values will be flagged and investigated. Failure may be due to transcription errors, microbalance malfunction, or samples not having reached equilibrium. Other QC checks (balance standards and lab blanks) will eliminate microbalance malfunction. If the duplicate does not meet the criterion, a second routine sample will be selected and reweighed as a second duplicate check. If this second check fails the acceptance criteria and the possibilities of balance malfunction and transcription errors have been eliminated, all samples in the batch will be equilibrated for another 24 hours and reweighed. Corrective actions will continue until duplicate weights for the batch meet acceptance criteria.

### 14.1.4 Accuracy or Bias Checks

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value. Four accuracy checks are implemented in the PM10 program:

- Collocated monitors
- Flow rate audits
- Balance checks
- FRM performance evaluations

**Collocated Monitors**

Although the collocated monitors are primarily used for evaluating and controlling precision, they can be used to determine accuracy or bias. By using Equation 19 to determine percent difference, one can track trends or bias between the two instruments without knowing which instrument is producing the "true" value. Use of the FRM performance evaluation information (discussed below) in conjunction with collocation data should help improve the quality of data.

**Corrective Action** - The percent difference of the paired values will be control charted to determine trends, if deemed necessary. If it appears that there is a statistically significant bias (> 10% at the 90% confidence level) between the pairs, corrective action will be initiated. The process will include eliminating uncertainties that may be occurring at filter handling, transport and laboratory stages, in order to determine that the bias is truly at the instrument. Corrective actions at the instrument will include multi-point temperature, pressure, and flow rate checks as well as complete maintenance activities. Additional corrective action could include a request for vendor servicing or a request for Region IX to implement an FRM performance evaluation.

**Flow Rate Audits**

The District will conduct flow rate audits quarterly. The ARB will conduct audits of District stations annually. Details of the implementation aspects of the audits are included in Element 11. An audit is conducted by measuring the monitor's normal operating flow rate using a certified flow rate transfer standard and comparing it with the monitor flow rate. The flow rate standard used for auditing will not be the same flow rate standard used to calibrate the monitor. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. The ARB and the District will report the audit (actual or volumetric) flow rate and the corresponding flow rate indicated or assumed by the sampler. The procedures used to calculate measurement uncertainty are described below.

**Accuracy of a Single Sampler - Single Check (Quarterly) Basis ($d_i$)** - The percentage difference ($d_i$) for a single flow rate audit *i* is calculated using Equation 11, where $X_i$ represents the audit standard flow rate (known) and $Y_i$ represents the indicated flow rate.

$$d_i = \frac{Y_i - X_i}{X_i} * 100$$

Equation 11

**Bias of a Single Sampler - Annual Basis ($D_j$) -** For an individual particulate sampler *j*, the average ($D_j$) of the individual percentage differences ($d_i$) during the calendar year is calculated using Equation 12, where $n_j$ is the number of individual percentage differences produced for sampler *j* during the calendar year.

$$D_j = \frac{1}{n_j} * \sum_{i=1}^{n_j} d_i$$

Equation 12

**Corrective Action** - The single sampler accuracy performance goal is $\pm$7% of the audit transfer standard and $\pm$10% of design flow rate. If the audit violates the acceptance criteria, the sample operator will check the sampling instrument for internal and external leaks, ensure that temperature and pressure are within acceptable ranges, and verify the flow rate. Another audit will be scheduled. If the audit is still unacceptable, a multi-point calibration followed by a one-point verification is required. Routine data, back to an acceptable audit or the most recent calibration, will be flagged and reviewed to determine validity (see Element 23). In addition, one would expect that the monthly flow rate calibration verification checks (see Element 16) would indicate a drift towards unacceptable accuracy. If a review of the flow rate calibration verification check data does not show a problem, there is a potential that one or both of the flow rate standards need to be recertified.

**Balance Checks**

Balance checks are frequent checks of the balance working standards (100 and 200 mg standards) against the balance to ensure that the balance is within acceptance criteria throughout the pre- and post-sampling weighing sessions. The District will use ASTM class 1 weights for its primary and secondary (working) standards. Both working standards will be measured at the beginning and end of the sample. Balance check samples can be controlled charted (see Table 14-3) when needed.

**Balance Check Evaluation-** The following equation will be used to evaluate the balance checks:

**Difference for a Single Check *($d_y$)*** - The difference, $d_y$, for each check is calculated using Equation 3, where $X$ represents the certified mass weight and $Y$ represents the reported weight,

Equation 3
$$d_y = Y - X$$

**Corrective Action** - The difference among the reported weight and the certified weight must be within ± 3µg. Since this is the first check before any pre- or post-sampling weighings, if this acceptance criterion is not met, corrective action will be initiated. Corrective action may be as simple as allowing the balance to perform internal calibrations or to sufficiently warm-up, which may require checking the balance weights a number of times. If the acceptance criterion is still not met, the laboratory technician will be required to verify the working standards by comparison with the primary standards. Finally, if it is established that the balance does not meet acceptance criteria for both the working and primary standards, and other troubleshooting techniques fail, the *Sartorius* service technician (see Element 15) will be called to perform corrective action.

If the balance check fails acceptance criteria during a weighing session, the 10 filters weighed prior to the failure will be reweighed. If the balance check continues to fail, troubleshooting, as discussed above, will be initiated. The values of the 10 samples weighed prior to the failure will be recorded and flagged, but will be remain with the unweighed samples in the batch to be reweighed when the balance meets the acceptance criteria. Any balance check outside the acceptance criterion will be flagged.

## 14.2 Control Charts

Control charts will not be used extensively by the District, however, the data used to produce them will be available and charts will be generated when and if the need arises. The control charts can be used as an "early warning system" to evaluate trends in precision and bias.

**Table 14.3 Control Charts**

| QC Check | Plotting technique |
|---|---|
| Flow rate calibration verification check | single values plotted |
| Lab/Field Blanks | mean value of each batch |
| Flow rate audit | single values plotted |
| Balance check | mean value of each batch |
| Collocated monitoring pairs | Percent difference each pair charted by site,<br>coefficient of variation each pair,<br>coefficient of variation of all sites per quarter. |

**References**

1. Taylor, J.K. 1987 Quality Assurance of Chemical Measurements. Lewis Publishers, Chelsea, Michigan. 328pp.

2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58. *Federal Register*, **62**(138):38763-38854. July 18, 1997.

3. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II: Quality Assurance Guidance Document 2.10: Monitoring PM10 in Ambient Air Using a High Volume Sampler, September 1997.

4. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II: Quality Assurance Guidance Document 2.11: Monitoring PM10 in Ambient Air Using a Dichotomous Sampler, September 1997.

5. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II: Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods; November 1998

6. U.S. EPA Other Test Method 30: Method to Quantify Particulate Matter Emissions from Windblown Dust, June 20, 2012

7. GBUAPCD Standard Operating Procedure for Mass Analysis of Fine Particulate Collected on Teflon Filters, October 2000

## 15.0 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

### 15.1 Purpose/Background

The purpose of this element of the District's QAPP is to address the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities are detailed in the District's laboratory and field operations SOPs (Appendices B, E, and F).

### 15.2 Testing

All PM10 monitors used in the District's PM10 Ambient Air Quality Monitoring Network are federal reference method (FRM) or federal equivalent method (FEM) monitors that have been designated as such by U.S. EPA. Therefore, they are, by virtue of their designation, of sufficient quality for the data collection operation. Testing of such equipment is accomplished through the procedures described in 40 CFR Part 53[1].

Prior to final field installation of all PM10 monitors, meteorological sensors, and Sensits, District staff will assemble and run the monitors in the field, following the Acceptance Test procedure in Appendix E. District field personnel will perform leak checks and temperature, pressure and flow rate verification checks of the PM10 monitors, calibration verification checks of the meteorological sensors, and sensitivity tests on the Sensits. If any of these checks are out of specification (see Table 14.1), the District will troubleshoot the monitor or sensor and contact the vendor for corrective action, if necessary. Once installed at the site, the District field personnel will run the tests mentioned above. If the sampling instrument or sensor meets the acceptance criteria, District staff will determine it to be operating properly and within specifications. These tests will be documented and filed as indicated in Element 9.

### 15.3 Inspection

Inspection of various pieces of equipment and components is provided here. Inspections are subdivided into two Elements: one pertaining to gravimetric laboratory issues and one associated with field activities.

#### 15.3.1 Inspection in Gravimetric Laboratory

There are several items that require routine inspection in the gravimetric laboratory. Table 15.1 details the items requiring inspection and how the inspection should be documented.

**Table 15.1 Inspections in the PM10 Gravimetric Laboratory**

| Item | Inspection Frequency | Inspection Parameter | Action if Item Fails Inspection | Documentation Requirement |
|---|---|---|---|---|
| Laboratory Temperature | Daily | 15 - 30$^{O}$ C | 1) Check HVAC System | 1) Document in laboratory log book<br><br>2) Notify Lab Manager |
| Laboratory Humidity | Daily | 20 - 45 %RH | 1) Check HVAC System | 1) Document in laboratory log book<br><br>2) Notify Lab Manager |
| Dust, damp mop laboratory | Monthly | Visually inspect | Clean Laboratory | Document in Laboratory log book |

## 15.3.2 Inspection of Field Items

There are several items to inspect in the field before and after samples and data have been collected. Tables 15.2, 15.3, and 15.4 detail the inspections performed in the field before and after these collections.

**Table 15.2 Inspection of Field Items – Filter-based and Continuous PM10 Monitors**

| Item | Inspection Frequency | Inspection Parameter | Action if Item Fails Inspection | Documentation Requirement |
|---|---|---|---|---|
| Sample downtube | Monthly | Visible particulate | Clean with a clean, lint-free cloth and/or compressed air | Document in log book |
| PM10 inlet, impactor | Weekly | Visible particulate | Clean with a clean, lint-free cloth and/or compressed air | Document in log book |
| Rain collector | Every site visit | Visible precipitation | Empty | Document in log book |
| O-rings | Every site visit | Any damage | Replace | Document in log book |
| Filter Magazine, (Filter-based monitors) | After each collection | Visible particulate | Note any issue | Document in log book |
| Cassette V-Seals, (Filter-based monitors) | Monthly | Clean and smooth | Clean with a clean, dampened lint-free cloth; replace as needed | Document when replaced |
| In-line filters | Every 6 months | Discoloration indicates particulate loading | Replace | Document in log book |
| Battery | Every 12 months | Decrease in voltage | Replace | Document in log book |

**Table 15.3 Inspection of Field Items – Meteorological Sensors**

| Item | Inspection Frequency | Inspection Parameter | Action if Item Fails Inspection | Documentation Requirement |
|---|---|---|---|---|
| Wind speed | Monthly | Prop Spin with wind | Check sensor bearings, verify upscale speeds | Document in log book and on calibration sheet |
| Wind direction | Monthly | Sensor points in correct direction during wind | Check sensor bearings, verify four cardinal directions | Document in log book and on calibration sheet |
| Ambient Temperature | Monthly | Compare with technician's sensor | Verify sensor response in temperature bath | Document in log book and on calibration sheet |
| Relative Humidity | Monthly | Compare with neighboring sensor | Verify sensor response in temperature bath | Document in log book and on calibration sheet |
| Barometric Pressure | Monthly | Compare with technician's sensor | Adjust sensor as necessary | Document in log book and on calibration sheet |
| Precipitation Sensor | Monthly | Clean and responds to manual tip | Clean with a dampened lint-free cloth or compressed air; verify response to manual tip on datalogger | Document in log book and on calibration sheet |

**Table 15.4 Inspection of Field Items – Sensits and Sand Catchers**

| Item | Inspection Frequency | Inspection Parameter | Action if Item Fails Inspection | Documentation Requirement |
|---|---|---|---|---|
| Cox Sand Catchers | Monthly | Inlet height, damage | Check sensor height with inspection tool, adjust as necessary; replace damaged inlets | Document in log book and on data sheet |
| Sensits | Monthly | Sensor ring height, sensitivity | Check sensor ring height with inspection tool, adjust as necessary; conduct tap test | Document in log book and on calibration sheet |

## 15.4 Maintenance

There are many items that require attention and regular maintenance in the monitoring network. This Element describes those items according to whether they are gravimetric laboratory items or field items.

### 15.4.1 Laboratory Maintenance Items

The successful execution of a preventive maintenance program for the gravimetric laboratory promotes the success of the entire PM10 program. In the District's PM10 network, gravimetric laboratory preventive maintenance is handled by District personnel and contractors**.** The laboratory technician handles all preventive maintenance associated with the heating, ventilation, and air conditioning system (HVAC). Preventive maintenance for the microbalance is performed by a *Sartorius* service technician contracted by the District. Preventive maintenance for the microbalance is scheduled to occur at initial set-up and every 12 months thereafter. In the event that there is a problem with the microbalance that cannot be resolved by District staff, the *Sartorius* service technician can be contacted.

The following table details the gravimetric laboratory maintenance items, replacement frequency, and specifies the party responsible for performing the maintenance.

**Table 15.5 Preventive Maintenance in Gravimetric Laboratories**

| Item | Maintenance Frequency | Responsible Party |
|---|---|---|
| Multi-point Microbalance and Top Loading Balance | Each weighing session<br><br>Yearly | *District Laboratory Technician,*<br>*Field Services Technician*<br>*Sartorius Service Technician* |
| Polonium strip replacement | 6 Months | *Laboratory Technician* |
| Comparison of NIST Standards to laboratory working and primary standards | Yearly | *Laboratory Technician* |
| Cleaning gravimetric laboratory | Monthly | *Laboratory Technician, Field Services Technician* |
| HVAC air filter inspection, replacement | Monthly<br>6 Months, or as needed | *Laboratory Technician* |
| Clean sticky floor mat<br>(just inside gravimetric laboratory) | Weekly | *Laboratory Technician* |
| HVAC system preventive maintenance | 6 Months, or as needed | *Laboratory Technician* |
| Computer Back-up | Monthly | *Laboratory Technician* |
| Computer Virus Check | Weekly | *Laboratory Technician* |
| Computer system preventive maintenance (clean out old files, compress hard drive, inspect) | Yearly | *Laboratory Technician* |

### 15.4.2 Field Maintenance Items

There are many items associated with appropriate preventive maintenance of the equipment in a successful field program. Table 15.6 details the appropriate maintenance checks of the PM10 samplers, meteorological sensors, and sand flux monitors and their frequency.

**Table 15.6 Preventive Maintenance of Field Items**

| Item | Maintenance Frequency | Location Maintenance Performed |
|---|---|---|
| **PM10 Monitors** | | |
| Clean PM10 Inlet | Weekly | At Site |
| Inspect Filter Cassettes | Each run | At Site and Lab |
| Replace In-line filter | 6 Months | At Site |
| Inspect Air Screens (under sampler's rain hood) | Monthly | At Site |
| Clean filter holding area, internal and external | Weekly | At Site |
| Sample Pump Rebuild | Every 10,000 hours of operation | At Field Office |
| **Meteorological Sensors** | | |
| Verify Operation | Monthly | At Site |
| Calibration Verification | 6 Months | At Site |
| Check nighttime battery voltage on datalogger | Monthly | At Office |
| **Sand Flux Monitors** | | |
| Sensits: wiring integrity | Monthly | At Site |

**References**

The following documents were utilized in the development of this Element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

2. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II: Quality Assurance Guidance Document 2.10: Monitoring PM10 in Ambient Air Using a High Volume Sampler, September 1997.

3. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II: Quality Assurance Guidance Document 2.11: Monitoring PM10 in Ambient Air Using a Dichotomous Sampler, September 1997.

4. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part II: Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods; November 1998

5. U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements Version 2.0, EPA-454/B-08-002, March 2008.

6. U.S. EPA Other Test Method 30: Method to Quantify Particulate Matter Emissions from Windblown Dust, June 20, 2012

7. GBUAPCD Standard Operating Procedure for Mass Analysis of Fine Particulate Collected on Teflon Filters, October 2000

# 16.0 Instrument Calibration and Frequency

## 16.1 Instrumentation Requiring Calibration

### 16.1.1 Mass Analysis by Gravimetry - Laboratory Microbalance

The laboratory support for the District includes calibration of the Sartorius M5P microbalance. As indicated in Element 13, the balances are calibrated (and mass standard check weights recertified) once per year under a service agreement. The service technician performs routine maintenance and makes any balance response adjustments that each calibration shows to be necessary. During the visit by the service technician, both the in-house primary and secondary (working) standards are checked against the service technician's standards to ensure acceptability. All of these actions are documented in the service technician's report, a copy of which is provided to the laboratory manager, which after review, is appropriately filed. The laboratory mass standards are also sent to the manufacturer annually for recertification. The mass standard recertification documents are reviewed by the laboratory manager and filed appropriately.

### 16.1.2 Flow Rate - Standards Laboratory

The District employs two primary flow rate standards, the Teledyne Hastings Bubble Flow Meter and the BIOS DryCal. The Teledyne Hastings Flow meter is a true primary standard thus is not calibrated or compared, the BIOS DryCal is sent to the manufacturer every three years for recertification.

The District Standards Laboratory employs two BGI Delta Cal flow meters for District Audits which are sent out annually to the manufacturer for recertification.

The field personnel use a Chinook Engineering Streamline Flowrate Transfer Standard (FTS) for flow rate verifications of all of the District's PM10 samplers flow rates. These devices have the advantage of providing volumetric flow rate values directly, without requiring conversion from mass flow measurements or water vapor corrections.

Upon initial receipt of any new, repaired, or replaced PM10 sampler, field support staff will perform a flow rate verification on the sampler to determine whether its initial performance is acceptable. Once sampler flow rates are accepted, the field personnel perform the calibration and verifications at the frequency specified in Element 14. The District Standards Laboratory directly performs or arranges to have another party perform the tests needed to recertify the District's standards.

### 16.1.3 Sampler Temperature, Pressure, Time Sensors-District Standards Laboratory

The District Standards Laboratory arranges support for the field calibration of temperature sensors by preparing and lab testing the temperature transfer standards. Field temperature transfer standards are compared against an ASTM mercury-in-glass thermometer bearing an NIST certification.

A stationary mercury barometer in the Laboratory is used as a primary standard to calibrate the electronic aneroid barometers that go into the field as transfer standards.

The District Laboratory verifies the time with the NIST@ Time clock which picks up the radio signal from Boulder, Colorado, against which other lab and field devices, including the volumetric flow meter and FRM samplers, are compared.

### 16.1.4 Field Instrumentation

As indicated in 16.1.3, the following calibrations are performed in the field:

- calibration of the mass flow meters (MFM) in the particulate samplers against a flow rate transfer standard
- calibration of sampler temperature and pressure sensors against the temperature transfer standard and pressure transfer standard

The field equipment and calibration instruments will follow the calibration and recertification schedule as listed in Table 16-1.

**Table 16-1 Field Equipment Calibration/Certification Schedule**

| Instrument | Frequency |
|---|---|
| R&P, Thermo, BGI FRM Single Filter Sampler<br>Mass Flow Meter<br>Ambient Temperature Sensor<br>Filter Temperature Sensor<br>Ambient Pressure Sensor | Annual or if verification check fails<br>“<br>“<br>“<br>“ |
| R&P, Thermo Sequential Filter Sampler<br>Mass Flow Meter<br>Ambient Temperature Sensor<br>Filter Temperature Sensor<br>Ambient Pressure Sensor | Annual or if verification check fails<br>“<br>“<br>“<br>“ |
| R&P, Thermo TEOM Continuous Monitor<br>Mass Flow Meter<br>Ambient Temperature Sensor<br>Ambient Pressure Sensor | Annual or if verification check fails<br>“<br>“<br>“ |
| Calibration Standard FTS orifice<br>Calibration Standard Temperature Sensor<br>Calibration Standard Pressure Sensor<br>Temperature Verification Standard<br>Pressure Verification Standard<br>Clock/Timer Verification Standard | Annual<br>Annual<br>Annual<br>Annual<br>Annual<br>Annual |

## 16.2 Calibration Methods

### 16.2.1 Laboratory- Gravimetric (Mass) Calibration

The calibration and QC (verification) checks of the microbalance and top-loading balance are addressed in Elements 13.3 and 16.1.1 and Appendix B and F of this QAPP. For the following three reasons, the multipoint calibration for the microbalance method will be zero, 100 and 200 mg: 1) the required sample collection filters weigh between 100 and 200 mg, 2) the anticipated range of sample loadings for the 24 hour sample period is rarely going to be more than 200 µg, and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing procedure precautions are taken for controlling contamination, or other sources of mass variation in the procedure (see SOP in the Appendix B).

Calibration and QC verification of the top-loading balance includes a multipoint calibration at three points at a minimum over the expected range of the samples to be weighed. Generally, calibration is performed with 100, 200, and 500-gram weights, however, certified weights are available up to 5 kilograms.

### 16.2.2 Flow Calibration for Filter-Based Samplers

Monthly Maintenance QC Checksheets will be submitted to the Air Monitoring managers together with the monthly data to ensure QA/QC checks are being performed per scheduled frequencies listed in Tables 6-4 and 7-4 in Elements 6 and 7, respectively.

**Method Summary:** After equilibrating the calibration device to the ambient conditions of the sampler, install a filter cassette containing an unused 46.2 mm filter in the sampler. After removing the inlet from the sampler, connect the flow calibration device on the sampler down tube. If the sampler has not been calibrated before, or if the previous calibration was not acceptable, perform a leak check according to the manufacturer's operational instruction manual, which is incorporated into the SOP in Appendix E.

Otherwise, place the sampler in calibration mode and perform a three-point calibration or a one-point flow rate verification. The field staff will only perform a leak check after calibration or if verification is outside of the acceptance criteria.

Following the calibration or verification, turn off the sampler pump, remove the filter cassette from the filter cassette holder, remove the flow rate calibration device, (and flow adaptor device if applicable), and replace the sampler inlet. If the flow rate is determined to be outside of the required target flow rate range, attempt to determine possible causes by minor diagnostic and troubleshooting techniques (e.g., leak checks, etc.), including those listed in the manufacturer's operating instruction manual. Do **not** attempt extensive field repairs or flow rate adjustments.

### 16.2.3 Flow Rate Calibration for Continuous Samplers

Monthly Maintenance QC Checksheets will be submitted to the Air Monitoring managers with the monthly data to ensure QA/QC checks are being performed per scheduled frequencies listed in Tables 6-4 and 7-4 in Elements 6 and 7, respectively.

**Method Summary:** After equilibrating the calibration device to the ambient conditions of the sampler, remove the inlet from the sampler, connect the flow calibration device on the sampler down tube. If the sampler has not been calibrated before, or if the previous calibration was not acceptable, perform a leak check according to the manufacturer's operational instruction manual, which is incorporated into the SOP in Appendix E.

Perform a mass flow calibration or flow verification. The field staff will only perform a leak check after calibration or if verification is outside of the acceptance criteria.

Following the calibration or verification, remove the flow rate calibration device, (and flow adaptor device if applicable), and replace the sampler inlet. If the flow rate is determined to be outside of the required target flow rate range, attempt to determine possible causes by minor diagnostic and troubleshooting techniques (e.g., leak checks, etc.), including those listed in the manufacturer's operating instruction manual. Do **not** attempt extensive field repairs or flow rate adjustments.

### 16.2.4 Sampler Temperature Sensor Calibrations

The ambient air temperature sensors will be calibrated once per year. The ambient air sensor is located inside the shielded fixture on the outside of the PM10 sampler and is easy to unfasten and remove for comparison to a transfer standard for temperature. The three-point calibration will be conducted at the field site.

For the filter based samplers the filter temperature sensor is located in the (open) space just below the filter cassette. Removal of plastic or metal fittings is required to remove the sensor and its associated wiring.

Several steps to follow in calibrating the temperature sensors are given in the SOP in Appendix E and in the following summary. Refer to the operator's instruction manual for sampler-specific procedures and instructions.

Remove the ambient temperature sensor from the radiation shield. Prepare a convenient container (an insulated vacuum wide mouth thermos bottle) for the hot temperature water bath, ambient temperature water bath and the ice slurry bath. Wrap the sensor(s) and a thermometer together with rubber band, ensure that all the probes are at the same level. Prepare the ambient or ice slurry solution according to the SOP in Appendix E. Immerse the sensor(s) and the attached thermometer in the ambient temperature bath. Wait at least 5 minutes for the ambient thermal mass and the sensor/thermometer to equilibrate.

For each thermal mass, in the order: Cold, Ambient, Hot, make a series of three measurements per temperature bath, taken about one minute apart. If the measurements indicate equilibrium, average the three readings and record the result as the sensor temperature relative to the thermometer.

A similar process will be used to verify the calibration of continuously-reading temperature sensors used in the gravimetric laboratory.

### 16.2.5 Sampler Pressure Sensor Calibrations

**General:** According to ASTM Standard D 3631 (ASTM 1977), a barometer can be calibrated by comparing it with a secondary standard traceable to a NIST primary standard.

**Precautionary Note:** Protect all barometers from violent mechanical shock and sudden changes in pressure. A barometer subjected to either of these events must be recalibrated. Maintain the vertical and horizontal temperature gradients across the instruments at less than 0.1°C/m. Locate the instrument so as to avoid direct sunlight, drafts, and vibration.

A Fortin mercury type of barometer is used in the Laboratory to calibrate and verify the aneroid barometer used in the field to verify the internal barometric sensors of the PM10 samplers. Details are provided in 16.4.1, below, and in Appendix E.

### 16.2.6 Sampler and Standard Volumetric Flow Rate Sensors with Built-in Clocks

Time can be verified over phone lines from NIST (in Boulder, Colorado, directly or through the NIST calibration service in Gaithersburg, MD) or from the NIST radio-linked clocks in Bishop or Keeler. Cellular phone times can also be used as they have proven to be nearly as accurate as NIST clocks. See Appendix B for details (or in NIST standardization handbooks and catalogues).

### 16.2.7 Verification of Relative Humidity Control/Monitoring Sensors for the Gravimetric Laboratory

A thermometer bearing an NIST-traceable certification is used by laboratory personnel to verify the temperature and a Psychrodyne powered wet bulb/dry bulb psychrometer is used to verify the relative humidity recorded by the Dickson weekly chart recorder and the Vaisala HMP35C sensor used to continuously monitor environmental conditions within the gravimetric laboratory. This procedure is detailed in Appendix B.

### 16.2.8 Verification of Relative Humidity Control/Monitoring Sensors for the Filter Based PM10 Samplers

A Psychrodyne powered wet bulb/dry bulb psychrometer is used to calibrate the relative humidity sensor within the filter compartment of the filter based PM10 samplers on an annual basis. This procedure is detailed in Appendix B.

## 16.3 Calibration Standard Materials and Apparatus

Table 16-2 presents a summary of the specific standard materials and apparatus used in calibrating measurement systems for parameters necessary to generate the PM10 data required in 40 CFR Part 58 and EPA Quality Assurance Guidance Documents 2.10 and 2.11.

## 16.4 Audit and Calibration Standards

### 16.4.1 Flow Rate Standards

The flow rate standard apparatus used for flow-rate calibration (field- NIST-traceable, MFM and orifice flow meter; Laboratory-NIST-traceable graphite piston flow meter and time monitor) has its own certification and is NIST-traceable. A calibration relationship for the flow-rate standard, such as an equation, curve, or family of curves, is established by the manufacturer (and verified if needed) to be accurate within 2% over the expected range of ambient temperatures and pressures at which the standard will be used. The District flow rate standard will be recalibrated every year in the case of the orifice flow meter.

The actual frequency with which this recertification process must be completed depends on the type of flow rate standard - some are more stable than others. The District Standards Laboratory will maintain a database from which control charts (a running plot of the difference or % difference between the flow-rate standard and the NIST-traceable primary flow-rate or volume standard) for all comparisons can be produced. The minimum recertification frequency is once per year. Field staff who conduct field calibrations will track changes from recertification to recertification to assure that performance is not compromised.

**Table 16-2 Standard Materials and/or Apparatus for PM2.5 Calibration**

| **Parameter**<br>M-Material<br>A=Apparatus | **Std. Material** | **Std. Apparatus** | **Mfr. Name** | **Model #** | **Variable Control Settings** |
|---|---|---|---|---|---|
| Mass M | Standard Check weight | NA | *Troemner* | Class 1 | NA |
| Temperature<br>M+A<br>M+A<br>M+A | <br>Hg<br>H20<br>NA | <br>Thermometer<br>Thermal mass (Thermos)<br>Thermistor | <br>*Brooklyn*<br>*TBD*<br>*TBD* | <br>PM<br>TBD<br>TBD | <br>*<br>NA<br>* |
| Pressure<br>M+A<br>A | <br>Hg<br>NA | <br>Fortin<br>Aneroid | <br><br>*TBD* | | <br>*<br>* |
| Flow Rate<br>A<br>A<br>A<br>A | <br>NA | <br>Piston Meter<br>Mass Flow Meter<br>Adapter<br>Orifice Flow Meter | <br>*BIOS*<br>*TBD*<br>*R&P, BGI*<br>*Chinook Engrg.* | | <br>*<br>NA<br>NA |
| Relative Humidity<br>A | <br>NA | <br>Sling Psychrometer | *Environmental Tectronics Corp.* | <br>Psychro-Dyne | |

*- See manufacturer's operating manual an/or instruction sheet

### 16.4.2 Temperature Standards

The operations manuals associated with the District's samplers identify types of temperature standards recommended for calibration and provide a detailed calibration procedure for each type that is specifically designed for the particular sampler.

The U.S. EPA Quality Assurance Handbook, Volume IV (EPA 2008), Section 3.4, provides information on calibration equipment and methods for assessing response characteristics of temperature sensors.

The temperature standard used for temperature calibration will have its own certification and be traceable to a NIST primary standard. A calibration relationship to the temperature standard (an equation or a curve) will be established that is accurate to within 2% over the expected range of ambient temperatures at which the temperature standard is to be used. The temperature standard must be re-verified and recertified at least annually. The District will use an ASTM- or NIST-traceable mercury in glass thermometer, for laboratory calibration.

### 16.4.3 Great Basin Unified APCD Standards

The temperature sensor standards chosen by the lab and field staff and managers are based on standard materials contained in a standardized apparatus; each has been standardized (compared in a strictly controlled procedure) against temperature standards the manufacturers obtained from NIST.

The District Laboratory standard is a NIST-traceable glass mercury thermometer from the *Brooklyn Thermometer Company*@, with a certificate summarizing the company's NIST traceability protocol and documenting the technician's signature, comparison date, identification of the NIST standard used, and the mean and standard deviation of the comparison results.

The District field temperature standards are thermocouples with digital readout modules. Each probe is calibrated with an NIST-traceable thermometer before being used in the field.

### 16.4.4 Pressure Standards

The GBUAPCD pressure standard is a Fortin-type mercury barometer. This type of barometer works on fundamental principles of length and mass and is therefore more accurate but more difficult to read and correct than other types. By comparison, the precision aneroid barometer is an evacuated capsule with a flexible bellows coupled through mechanical, electrical, or optical linkage to an indicator. It is potentially less accurate than the Fortin type but can be transported with less risk to the reliability of its measurements and presents no danger from mercury spills. The Fortin type of barometer is best employed as a higher quality laboratory standard used to adjust and certify an aneroid barometer in the laboratory. The District's field working standard is an aneroid barometer with digital readout.

## 16.5 Calibration Frequency

See Table 14.1 for a summary of field QC checks that includes frequency and acceptance criteria and references for calibration and verification tests of single and sequential sampler flow rate, temperature, pressure, and time. See Table 14-2 for a similar summary of laboratory QC checks, including frequency of primary and working mass standard measurements and conditioning/weighing room temperature and relative humidity measurements.

For the filter based PM10 samplers, the flow rate, temperature and pressure sensor verification checks include 1-point checks that are performed at least monthly. For the continuous PM10 samplers these same checks are performed biweekly. Multipoint flow rate, multipoint temperature, and single point pressure sensor calibrations are performed at least annually on both filter-based and continuous PM10 samplers.

All of these activities, as well as sampler and calibration equipment maintenance, are documented in field data records and notebooks and annotated with the flags noted in Appendix L of 40 CFR Part 50, the manufacturer's operating instruction manual, and any documents indicated in Element 22.7.2 of this document. Laboratory and field activities associated with equipment used by the respective technical staff will be kept in record notebooks as well. The records will normally be controlled by the managers, and located in the labs or field sites when in use.

## References

1. ASTM. 1977. Standard test methods for measuring surface atmospheric pressure. American Society for Testing and Materials. Philadelphia, PA. Standard D 3631-84.

2. ASTM. 1995. Standard test methods for measuring surface atmospheric pressure. American Society for Testing and Materials. Publication number ASTM D3631-95.

3. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

4. EPA. 1997b. Ambient air monitoring reference and equivalent methods. U.S. Environmental Protection Agency. 40 CFR Part 53, as amended July 18, 1997.

5. EPA. 1997. Reference method for the determination of fine particulate matter as $PM_{2.5}$ in the atmosphere. U.S. Environmental Protection Agency. 40 CFR Part 58, Appendix L, as amended July 18, 1997.

6. EPA. 2008. Quality Assurance Handbook for Air Pollution Measurement Systems Volume IV Version 2.0: Meteorological Measurements. U.S. Environmental Protection Agency. Document No. EPA-454/B-08-002. Revised March, 2008.

7. NIST. 1976. Liquid-in-glass thermometry. National Institute of Standards and Technology. NBS Monograph 150. January.

8. NIST. 1986. Thermometer calibration: a model for state calibration laboratories. National Institute of Standards and Technology. NBS Monograph 174. January.

9. NIST. 1988. Liquid-in-glass thermometer calibration service. National Institute of Standards and Technology. Special publication 250-23. September.

10. NIST. 1989. The calibration of thermocouples and thermocouple materials. National Institute of Standards and Technology. Special publication 250-35. April.

# 17.0 Inspection/Acceptance for Supplies and Consumables

## 17.1 Purpose

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the PM10 Program. The District PM10 monitoring network relies on various supplies and consumables that are critical to its operation. Having documented inspection and acceptance criteria helps ensure the consistency of the supplies. This Element details the supplies/consumables, their acceptance criteria, and the required documentation for tracking this process.

## 17.2 Critical Supplies and Consumables

There are many components to the District's PM10 monitoring network. This Element describes the needed supplies for this network and includes items for the gravimetric laboratory and the field. Table 17.1 presents the supplies and consumables that are critical to the operation of the PM10 network.

**Table 17.1 Critical Supplies and Consumables**

| **Area** | **Item** | **Description** | **Vendor** | **Model Number** |
|---|---|---|---|---|
| Sampler | Rain Collector | Glass | R & P<br>BGI | *To be determined*<br>*To be determined* |
| Sampler | V-seals | The V-seals that seal in the filter cassette when it is placed in the sampler. | *Thermo* | |
| Sampler | In-line Filter | Downstream of sample collection and upstream of sample pump. | Thermo | *To be determined*<br>*To be determined* |
| Sampler | Battery | Internal Sampler Battery. | Thermo | *To be determined*<br>*To be determined* |
| Sampler | Fuses | In sampler | Thermo | *To be determined*<br>*To be determined* |
| Filter | Filters | 46.2 mm teflon | MTL via EPA | 7592-004 |
| Filter | Petri-dish | 47 mm with securing ring. | Pall | 7231 |
| Filter | Filter Cassettes (single) | As per CFR design | Thermo | *N/A*<br>*N/A* |
| Filter | Filter Cassette Holder, Protective Containers | For securing cassette(s) | Thermo | *N/A* |
| Filter | Sequential Sampler Cassette Magazine | For use with R&P and Thermo Samplers | Thermo | *N/A* |
| Filter | Filter Handling Containers | For transport to and from the field | *To be determined* | *N/A* |
| Gravimetric Laboratory | Staticide | Anti-static solution | Cole-Parmer | E-33672-00 |
| Gravimetric Laboratory | Static Control Strips | Polonium 210$\mu C_i$ | Thomas Scientific | 3620A65 |
| Gravimetric Laboratory | Air Filters | High Efficiency | Grainger | 6B948 |

| Area | Item | Description | Vendor | Model Number |
|---|---|---|---|---|
| All | Powder Free Antistatic Gloves | Vinyl, Class M4.5 | Fisher Scientific | Small 11-393-85A<br>Medium 11-393-85A<br>Large 11-393-85A<br>X-Large 11-393-85A |
| All | Low-lint wipes | 4.5" x 8.5" Cleaning Wipes | Kimwipes | 34155 |

## 17.3 Acceptance Criteria

Acceptance criteria must be consistent with overall project technical and quality criteria. Some of the acceptance criteria are specifically detailed in 40 CFR Part 50. Other acceptance criteria such as observation of damage due to shipping can only be performed once the equipment has arrived on site.

Table 17.2 details the acceptance test and limits for procurement of supplies and consumables to be utilized in the District's PM10 network.

**Table 17.2 Acceptance Criteria for Supplies and Consumables**

| Equipment | Acceptance Criteria | Action if Requirements not met |
|---|---|---|
| Rain Collector | Not broken | Call Vendor, will likely not return |
| O-Rings, V-seals | Of the correct size | Return |
| In-line Filter | Of the correct size | Return |
| Battery | Correct size and voltage | Return |
| Fuses | Correct size and specification | Return |
| Filters, 46.2 mm Teflon | Tested and Accepted by the U.S. EPA with documentation of acceptance in package. Should meet visual inspection and pre-weight (110-160mg) criteria | Call David Lutz, U.S. EPA (919) 541-5476 |
| Petri-dish | Clean and appropriately sized for 46.2 mm filters | Return |
| Filter Cassettes (single) | Of the correct type and make | Return |
| Filter Cassette Holder, Protective Containers | Of the correct size so that filter cassettes will not move around that could potentially lead to dislodging particulate | Return |
| Sequential Sampler Cassette Holder | Of the correct type for use with the sequential sampler model | Return |
| Filter Handling Containers | Clean | Clean |
| Anti-Static Solution | Of the correct type | Return |
| Static Control Strips | Manufactured within past 3 months and 210$\mu C_i$ of Polonium | Call vendor |
| Air Filters | Of the size and quality specified | Return |
| Powder Free Antistatic Gloves | Of the size and quality specified | Return |
| Cleaning Wipes | Of the quality specified | Return |

## 17.4 Tracking and Quality Verification of Supplies and Consumables

Tracking and quality verification of supplies and consumables have two main components. The first is the need of the end user of the supply or consumable to have an item of the required quality. The second need is for the purchasing department to accurately track goods received so that payment or credit of invoices can be approved. In order to address these two issues, the following procedures outline the proper tracking and documentation activities to follow:

1. Receiving personnel will perform a rudimentary inspection of the packages as they are received from the courier or shipping company. Note any obvious problems with a receiving shipment such as crushed box or wet cardboard.

2. The package will be opened, inspected and contents compared against the packing slip.

3. Supply/consumable will be compared to the acceptance criteria in Table 17.2.

4. If there is a problem with the equipment/supply, note it on the packing list, notify the supervisor of the receiving area and immediately call the vendor.

5. If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and send to accounts payable so that payment can be made in a timely manner.

6. Notify appropriate personnel that equipment/supplies are available. For items such as the 46.2 mm Teflon filters, it is critical to notify the laboratory manager of the gravimetric laboratory so sufficient time for de-gassing of the filters can be allowed.

7. Stock equipment/supplies in appropriate pre-determined area.

8. For supplies, consumables, and equipment used throughout the PM10 program, document when these items are changed out. If available, include all relevant information such as: model number, lot number, and serial number.

## 18.0 Data Acquisition Requirements

This Element addresses data not obtained by direct measurement from the PM10, Meteorological, and Sand Flux Monitoring Program. This includes both outside data and historical monitoring data. Non-monitoring data and historical monitoring data are used by the Program in a variety of ways. Use of information that fails to meet the necessary Data Quality Objectives (DQOs) for the PM10 Ambient Air Quality Monitoring Program can lead to erroneous trend reports and regulatory decision errors. The policies and procedures described in this element apply both to data acquired through the District monitoring program and to information previously acquired and/or acquired from outside sources.

### 18.1 Acquisition of Non-Direct Measurement Data

The PM10 Ambient Air Quality Monitoring Program relies on data that are generated through field and laboratory operations, however, other significant data are obtained from sources outside the District or from historical records. This Element lists these data and addresses quality issues related to the PM10 Ambient Air Quality Monitoring Program.

**Chemical and Physical Properties Data**

Chemical and physical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that has not already been specified in the monitoring regulations will be obtained from nationally and internationally recognized sources. The following sources may be used in the PM10 Ambient Air Quality Monitoring Program without prior approval:

- National Institute of Standards and Technology (NIST)
- ISO, IUPAC, ANSI, other recognized national and international standards organizations
- U.S. EPA
- The current edition of certain standard handbooks may be used without prior approval. Two that are relevant to the fine particulate monitoring program are CRC Press' *Handbook of Chemistry and Physics*, and *Lange's Handbook.*

**Geographic Location**

Another type of data that will commonly be used in conjunction with the PM10 Ambient Air Quality Monitoring Program is geographic information. For the current sites, the District will locate these sites using the global positioning systems (GPS). These locations will then be uploaded to the District’s Geographical Information System (GIS) database.

**Historical Monitoring Information of the District**

The District has operated a network of ambient air monitoring stations since the 1970's. Historical monitoring data and summary information derived from that data may be used in conjunction with current monitoring results to calculate and report trends in pollutant concentrations. In calculating historical trends, it is important to verify that historical data are fully comparable to current monitoring data. If different methodologies were used to gather the historical data, the biases and other inaccuracies must be described in trends reports based on that data. Direct comparisons of PM10 with historical TSP or PM10 data will not be reported or used to estimate trends. Dichotomous sampler data (fine portion) may be used to establish trends in

PM2.5 concentration; however, evidence must be presented to demonstrate that results of the two methods are comparable.

**External Monitoring Data Bases**

Users should review available QA/QC information to assure that the external data from other organizations or entities are comparable with District measurements and that the original data generator had an acceptable QA program in place. It is the policy of the District that no data obtained from any other organization or agency shall be used in creating published reports or regulatory actions unless the data were collected under a QA program that meets the requirements of 40 CFR Part 58, and has been approved by the ARB's Quality Assurance Section Manager or the US EPA. Such data that have received approval may be entered into AQS.

Data from the U.S. EPA AQS database may be used in published reports with appropriate caution. Care must be taken in reviewing/using any data that contain flags or data qualifiers. If data are flagged, such data shall not be utilized unless it is clear that the data still meet critical QA/QC requirements. It is impossible to assure that a data base such as AQS is completely free from errors including outliers and biases, so caution and skepticism is called for in comparing District data with data from other reporting agencies as reported in AQS.

**Meteorological Data From Other Sources**

Meteorological data are gathered from other sources such as the U.S. National Weather Service sites to provide information required when developing monitoring sites, computing corrections needed to convert from standard conditions to local conditions, and to support analysis and modeling efforts. These data are not reported to AQS and are clearly identified when used in assessment and modeling efforts.

# 19.0 Data Management

## 19.1 Background and Overview

This Element describes the data management operations pertaining to PM10, Meteorological, and Sand Flux measurements for the monitoring stations operated by the Great Basin Unified APCD (District). This Element includes an overview of the data management operations and analyses performed on raw ("as-collected") data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

Data processing activities for PM10 data are summarized in Figures 19..1 (Partisol) and 19..2 (TEOM). The activities for processing meteorological sensor data are similar to those used for continuous PM10 (TEOM) data processing and are also included in Figure 19.2. Data processing steps are integrated, to the extent possible, into the existing data processing system used for the District's SLAMS network. All sampling data will be entered into a data management system (DMS) either through manual entry, electronic transfer from the field, or both. The DMS data are stored on a database running on a secure PC-compatible platform.

The District utilizes two general PM10 monitors: R&P/Thermo Partisols for filter-based monitoring; and R&P/Thermo TEOMs for continuous PM10 monitoring. Data collected from the filter-based monitors follow a different data-handling track than data collected from the TEOM continuous PM10 monitors. Each dataset is discussed separately in sections 19.1.1 and 19.1.2, below.

### 19.1.1 Filter-based PM10 Data

All PM10 mass results are electronically transferred from the microbalance to a dedicated gravimetric laboratory computer, where the final concentrations are calculated. The data from the laboratory are provided to the data management group electronically and in hardcopy form. The hardcopy data are then manually entered into the database by the data management group as a final QC check. This process is shown in Figure 19.1.

Filter tracking and chain of custody information are entered into the PM10 DMS at two main stages as shown in Figure 19.1. The systems analysts are able to obtain reports on status of samples using the DMS. All users must be authorized by the Senior Research & Systems Analyst of the data processing group, and receive permission necessary to log on to the DMS. Once permission is received, all data processing privileges are available to the authorized user.

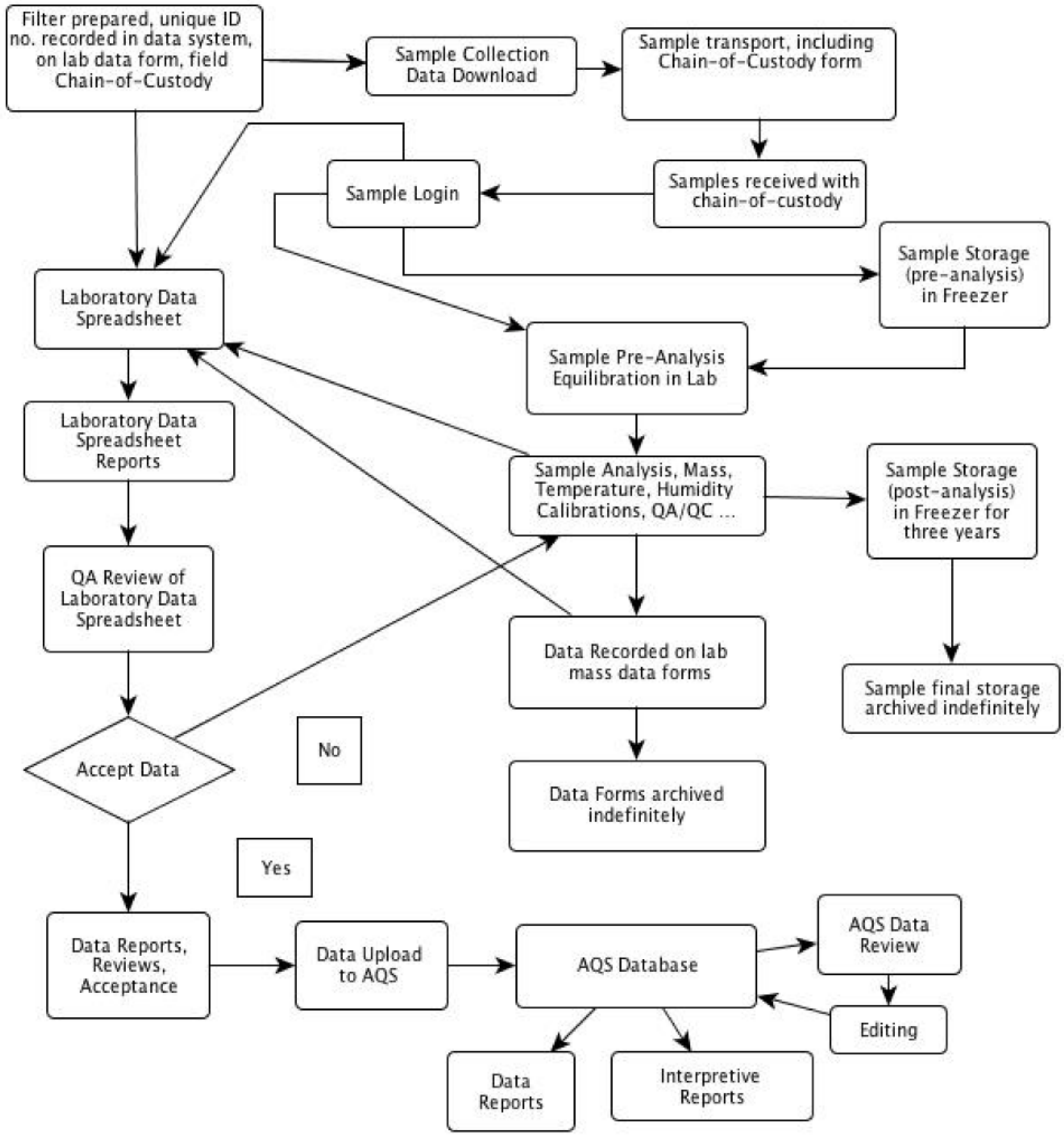


**Figure 19.1 Filter-Based PM10 data flow diagram**

### 19.1.2 Continuous PM10 Data

All PM10 data are manually downloaded each month directly from the TEOM continuous PM10 monitor by the station operator to a laptop via RPCOM. The station operator then emails the downloaded PM10 data to the District Database Manager (Research and Systems Analyst II) in the data management group to incorporate the raw data into the DMS. Site Maintenance records are also transmitted to the Database Manager, either in hardcopy or electronic form.

The TEOM database is maintained separately from the Partisol filter-based monitor database. While the Senior Research and Systems Analyst is the primary keeper of the Partisol filter-based monitor database, the Database Manager is responsible for the TEOM database. The TEOM database is secured so that only the Database Manager can make changes/additions/deletions.

Every month, the Database Manager reconciles the site maintenance records with the PM10 data, logging all events that may have influenced PM10 values into the database and invalidating where appropriate, and assigning Qualifier Codes (see Table 6.1.5). This process is shown in Figure 19.2.

### 19.1.3 Meteorological Data

Meteorological data are downloaded each workday directly from the datalogger by the polling computer via radio telemetry or cellular modem. The data are checked by the District Database Manager (Research and Systems Analyst II) in the data management group to incorporate the raw data into the DMS. Site Maintenance records are transmitted to the Database Manager, either in hardcopy or electronic form.

The meteorological database is maintained separately from the PM10 monitor database. The Database Manager is responsible for the meteorological database. The meteorological database is secured so that only the Database Manager can make changes/additions/deletions.

Every month, the Database Manager reconciles the site maintenance records with the meteorological data, logging all events that may have influenced meteorological values into the database and invalidating where appropriate, and assigning Qualifier Codes (see Table 6.1.5). This process is shown in Figure 19.2.

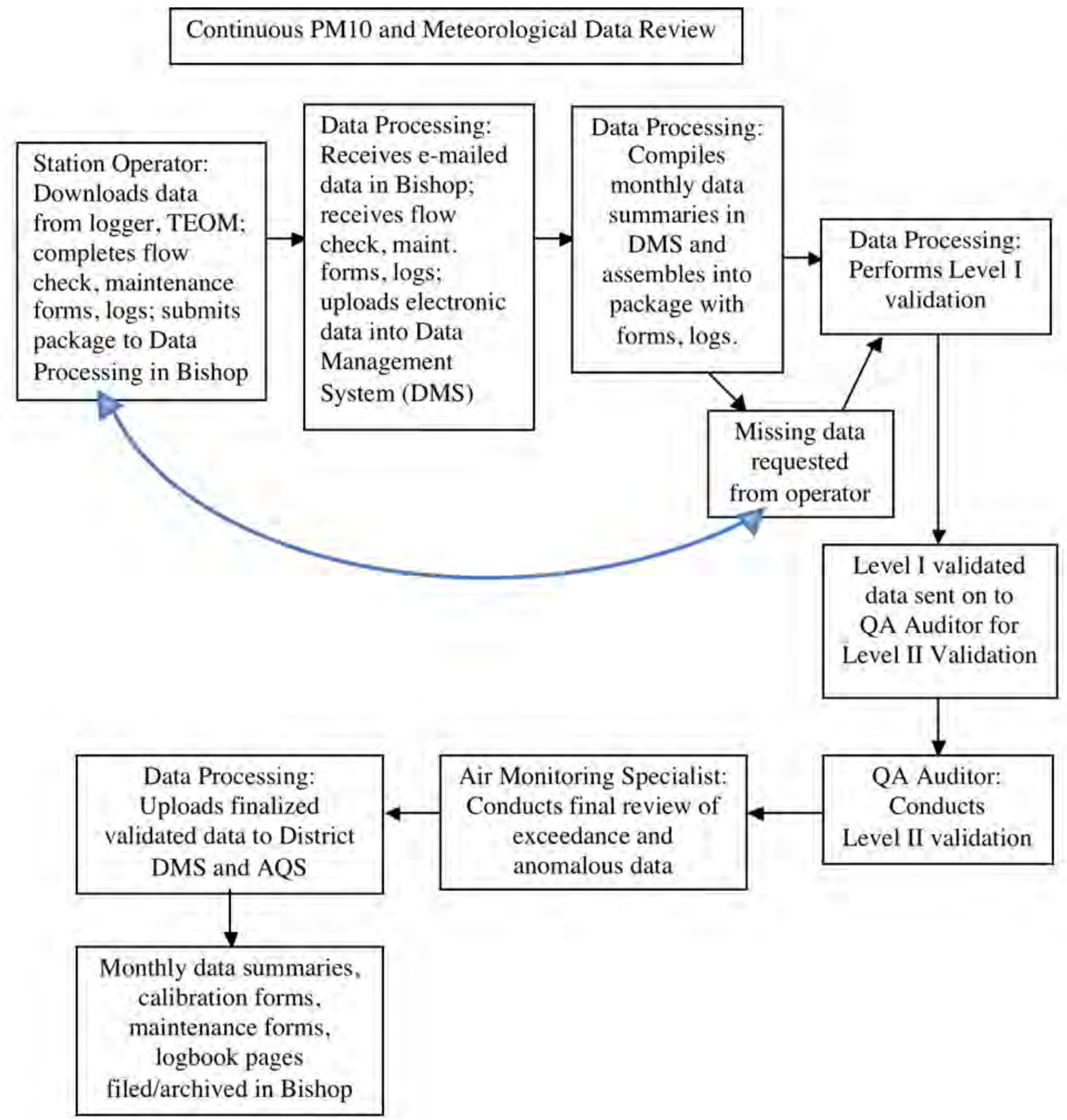


**Figure 19.2 Continuous PM10 and Meteorological Data Flow Diagram**

### 19.1.4 Dataloggers

The continuous PM10 monitors record particulate data at each PM10 monitoring station. Additionally, Campbell Scientific dataloggers are programmed to record meteorological sensor data and shelter temperature data, as well as the PM10 monitor data. Manually-downloaded digital PM data directly from the TEOM is the preferred continuous PM data source, however, there are occasional cases when a TEOM has malfunctioned and lost the recorded PM data from within its memory. On these occasions, analog PM data, collected by the datalogger, may be considered for use as the data of record.

All monitoring stations are remotely accessible via computer network, fax-modem, or cellular connection. Meteorological, shelter temperature, and analog PM data are collected hourly and posted and graphed on the District website for instantaneous review by station operators and the data management group. The District is in the initial stages of enabling remote access to digital data stored on TEOMs, allowing station operators to check their monitor status, flow rates and temperatures, and download digital PM data remotely directly from the TEOMs. The District anticipates the TEOMs at sites connected to the LAN network will be connected by the end of 2013. However, due to slow transfer rates, remote sites connected via fax-modem and cellular modem may continue to require manual PM data download.

## 19.2 Data Recording

Data entry, validation, and verification functions are all part of the overall data management process. Filter-based monitor data from the gravimetric lab forms shown in Figure 19.1 are entered by laboratory personnel. Procedures for filling out the laboratory data sheets and subsequent data entry are provided in laboratory SOP presented in Appendix B. TEOM data are downloaded by the station operator to a laptop computer and transmitted to the data management group via email.

## 19.3 Data Validation

Data validation involves verifying that data processing operations have been carried out correctly and involves monitoring the quality of the field operations as evidenced by the field documentation. Data validation can identify problems in either of these areas. Once problems are identified, the data can be corrected or invalidated, and corrective actions can be taken for field or laboratory operations. Numerical data stored in the DMS are never internally overwritten by condition flags. Flags denoting error conditions or QA status are saved as separate fields in the database, so that it is always possible to recover the original data.

The following validation functions are part of the District's data management process and are used to ensure the quality of data entry and data processing operations:

- **Range Checks** - almost all monitored parameters have simple range checks programmed in. For example, valid times must be between 00:00 and 23:59, etc. The station operator is notified by the data management group when a value is out of range.
- **Completeness Checks** - When the data are processed, certain completeness criteria must be met. For example, for filter-based PM10 data, each filter must have a start time, an

end time, an average flow rate, dates weighed, and operator and technician names. These entries are verified by the laboratory technician and by the data reviewer.

- **Internal Consistency and Other Reasonableness Checks -** Several other internal consistency checks are part of the data management process. For example, for filter-based PM10 data, the end time of a filter sampling period must be greater than the start time. Computed filter volume (integrated flow rate over the monitoring period) must be approximately equal to the exposure time multiplied by the nominal flow. Additional consistency and other checks will be implemented as the result of problems encountered during data screening.
- **Data Retention** - Raw field data forms are retained on file in the District's main office for a minimum of five years, and are readily available for audits and data verification activities. After five years, records are scanned to searchable pdfs and the hardcopies are destroyed. Physical samples such as filters are also cataloged and boxed for storage for a minimum of five years.
- **Statistical Data Checks** - Errors found during statistical screening will be traced back to original data entry files and to the raw data sheets, if necessary. These checks shall be conducted on a monthly schedule and prior to any data submission to AQS. Data validation is the process by which raw data are incorporated into the DMS, reviewed in partnership with maintenance records, and deemed either as valid or invalid.
- **Sample Batch Data Validation**- which is discussed in Element 23, associates flags that are generated by QC values outside of acceptance criteria, with a sample batch. Batches containing more than one flag may be rerun and/or invalidated.

## TEOM and Meteorological Data Review and Validation

Upon monthly receipt of TEOM and meteorological data from the station operators, the District's database manager reconciles site maintenance activities with the PM10 and meteorological data, invalidating data when appropriate. Table 19.1 summarizes the validation checks applicable to the PM10 data.

**Table 19.1 Validation Check Summaries**

| Type of Data Check | Electronic Transmission and Storage | Manual Checks | Automated Checks |
|---|---|---|---|
| Data Parity and Transmission Protocol Checks | X | X | |
| Date and Time Consistency | X | X | X |
| Completeness of Required Fields | X | X | X |
| Range Checking | | X | |
| Statistical Outlier Checking | | X | |
| Manual Inspection of Charts and Reports | | X | |
| Sample Batch Data Validation | | X | |

One key operational criterion for PM10 sampling is precision. As defined in 40 CFR Part 58, Appendix A, precision is based on differences between collocated sampler results. The District will inspect the results of collocated sampling during each quarterly data review activity. These data will be evaluated as early in the process as possible, so that potential operational problems can be addressed. The objective of the District will be to optimize the performance of its PM10 monitoring equipment. Initially, the results of collocated operations will be assembled into control charts (see Element 14). From these charts, control limits can be established to flag potential problems. Multiple collocation results must be accumulated to assess data quality with confidence. However, even limited data can be used for system maintenance and corrective action.

## 19.4 Filter-based PM10 Data Transformation

Calculations for transforming raw filter-based PM10 data from measured units to final concentrations are relatively straightforward, and many are carried out in the sampler before being recorded. The following relations in Table 19.2 pertain to filter-based PM10 monitoring:

**Table 19.2 Raw Filter-based Data Calculations**

| Parameter | Units | Type of Conversion | Equation |
|---|---|---|---|
| Filter Volume ($V_a$) * | $m^3$ | Calculated from average Flow Rate ($Q_{ave}$) in L/min, and total elapsed time (t) in min. multiplied by the unit conversion ($m^3$/L) | $V_a = (Q_{ave} \times t)/10^3$ |
| Mass on Filter ($M_{10}$) | µg | Calculated from filter post-weight ($M_f$) in mg and filter pre-weight ($M_i$) in mg, multiplied by the unit conversion (µg/mg) | $M_{ID} = (M_f - M_i) \times 10^3$ |
| $PM_{10}$ Concentration ($C_{PM10}$) | µg/ $m^3$ | Calculated from laboratory data and sampler volume | $PM10 = (M_{ID}/V_a)$ |

## 19.5 Data Transmittal

Data transmittal is the transfer of data from one person or location to another or when data are copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file or electronic transfer of data over a telephone or computer network. Table 19.3 summarizes the District's data transfer operations.

**Table 19.3 Data Transfer Operations**

| Description of Data Transfer | Originator | Recipient | QA Measures Applied |
|---|---|---|---|
| Electronically Transmit Weighing Data from balance into Laboratory Spreadsheet and write information on laboratory data forms | Laboratory Technician (handwritten data form) | Data Processing Personnel | Entered from hardcopy printouts of spreadsheets into District database |
| Electronic data transfer | (between computers or over network) | Data Processing Personnel | Parity Checking; transmission protocols |
| Filter Receiving and Chain-of-Custody | Field Technician | Laboratory Technician | Filter numbers are verified manually |
| AQS data summaries | Systems Analyst | AQS (U.S. EPA) | Sr. Systems Analyst |

The District will report all PM10 ambient air quality data and information specified by the AQS Users Guide (Volume II, Air Quality Data Coding, and Volume III, Air Quality Data Storage) or its replacement, coded in the AIRS-AQS format. Such air quality data and information will be fully screened and validated and will be submitted directly to the AIRS-AQS via electronic transmission in accordance with the quarterly schedule. The specific quarterly reporting periods and due dates are shown in the Table 19.4.

**Table 19.4 Data Reporting Schedule**

| Reporting Period | Due Date |
|---|---|
| January 1-March 31 | June 30 |
| April 1-June 30 | September 30 |
| July 1-September 30 | December 31 |
| October 1-December 31 | March 31 |

## 19.6 Data Reduction

Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. The PM10 monitoring regulations require certain summary data to be computed and reported regularly to U.S. EPA. Other data are reduced and reported for other purposes such as station maintenance. Examples of data summaries include:

- average PM10 concentration for a station or set of stations for a specific time period
- accuracy and precision statistics based on accumulated FRM/FEM data
- data completeness reports based on numbers of valid samples collected during a specified period

The audit trail is another important concept associated with data transformations and reduction. An audit trail is a data structure that provides documentation for changes made to a data set during processing. Typical reasons for data changes that would be recorded include:

- correction of data input due to human error
- application of revised calibration factors
- addition of new or supplementary data
- flagging of data as invalid or suspect
- logging of the date and times when automated data validation programs are run

The DMS audit trail is implemented in the District data management process. Audit trail records will include the following fields:

- operator's identity
- date and time of the change
- table and field names for the changed data item
- reason for the change
- full identifying information for the item changed (date, time, site location, parameter, etc.)
- value of the item before and after the change

The audit trail documents changes, therefore, there is the ability to reverse changes after they have been incorporated into the system.

## 19.7 Data Analysis

The District is currently implementing the data summary and analysis requirements contained in 40 CFR Part 58, Appendix A. It is anticipated that as the PM10 Monitoring Program continues, additional data analysis procedures may be developed. The following specific summary statistics will be tracked and reported for the PM10 monitoring network:

- Single sampler accuracy (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Single sampler precision (based on collocated data)
- Network-wide precision (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Data completeness

Equations used for these reports are presented in the Table 19.5.

**Table 19.5 Report Equations**

| Criterion | Equation | Reference |
|---|---|---|
| Automated Sampler Precision: Flow - Single Check ($d_i$) $X_i$ is reference flow; $Y_i$ is measured flow (Equation also used for Single Sampler Accuracy) | $d_i = [(Y_i - X_i) / X_i] \times 100$ | 40 CFR 58 Appendix A, Section 4.1.1, Equation 1 |
| Single Sampler Precision ($d_i$) - $X_i$ and $Y_i$ are concentrations from the primary and duplicate samplers, respectively. | $d_i = [(Y_i - X_i) / (Yi - X_i)^2] \times 100$ | 40 CFR 58 Appendix A, Section 4.2.1, Equation 10 |
| Completeness | $\text{Completeness} = N_{valid}/N_{total} \times 100$ | -- |

## 19.8 Data Flagging - Sample Qualifiers

Continuous data derived from PM10 TEOMs, and meteorological sensors, which are deemed invalid, are assigned a Qualifier Code, which explains the reason for the invalidation. The most appropriate Qualifier Code is selected from Table 19.6 and assigned to every invalid data record and to those time spans which lack data for any monitored parameter.

Table 19.6 – Qualifier Codes (Null Data Codes) assigned to invalid/null data .

| Qualifier Code | Qualifier Description |
|---|---|
| AA | Sample Pressure out of Limits |
| AB | Technician Unavaliable |
| AC | Construction/Repairs in Area |
| AD | Shelter Storm Damage |
| AE | Shelter Temperature Outside Limits |
| AF | Scheduled but not Collected |
| AG | Sample Time out of Limits |
| AH | Sample Flow Rate out of Limits |
| AI | Insufficient Data (cannot calculate) |
| AJ | Filter Damage |
| AK | Filter Leak |
| AL | Voided by Operator |
| AM | Miscellaneous Void |
| AN | Machine Malfunction |
| AO | Bad Weather |
| AP | Vandalism |
| AQ | Collection Error |
| AR | Lab Error |
| AS | Poor Quality Assurance Results |
| AT | Calibration |
| AU | Monitoring Waived |
| AV | Power Failure |
| AW | Wildlife Damage |
| AX | Precision Check |
| AY | Q C Control Points (zero/span) |
| AZ | Q C Audit |
| BA | Maintenance/Routine Repairs |
| BB | Unable to Reach Site |
| BC | Multi-point Calibration |
| BD | Auto Calibration |
| BE | Building/Site Repair |
| BF | Precision/Zero/Span |
| BG | Missing ozone data not likely to exceed level of standard |
| BH | Interference/co-elution/misidentification |

| | |
|---|---|
| BI | Lost or damaged in transit |
| BJ | Operator Error |
| BK | Site computer/data logger down |
| BL | QA Audit |
| BM | Accuracy check |
| BN | Sample Value Exceeds Media Limit |
| CS | Laboratory Calibration Standard |
| DA | Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts) |
| DL | Detection Limit Analyses |
| FI | Filter Inspection Flag |
| MB | Method Blank (Analytical) |
| MC | Module End Cap Missing |
| SA | Storm Approaching |
| SC | Sampler Contamination |
| ST | Calibration Verification Standard |
| TC | Component Check & Retention Time Standard |
| TS | Holding Time Or Transport Temperature Is Out Of Specs. |
| XX | Experimental Data |

For filter-based PM10 data, a sample qualifier or a result qualifier consists of two to four alphanumeric characters which act as an indicator of the fact and the reason that the data value: (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the laboratory. Qualifiers will be used both in the field and in the laboratory to signify data that may be suspect due to contamination, special events, or failure to meet QC limits. Some flags may be generated by the sampling instrument. Appendix C contains a complete list of the data qualifiers for the field and laboratory activities. Qualifiers will be placed on field and bench sheets with additional explanations in free form notes areas. When sample batch information is entered into the DMS and validated, (see Element 23) flags will be applied as necessary. Table 19.7 lists the sample batch flags that will be used in the DMS.

**Table 19.7 Sample Batch Quality Control Flags**

| Requirement | Acceptance Criteria | Flag |
|---|---|---|
| ***Blanks*** | | |
| Field Blanks | $>\pm 30$ µg difference | FB |
| Lab Blanks | $>\pm 15$ µg difference | LB |
| ***Precision Checks*** | | |
| Laboratory Duplicate | $\pm 15$ µg | REP |
| ***Accuracy*** | | |
| Balance Check | $\leq 3$ µg | BC |

During the sample validation process, the flags will be used to decide on validating or invalidating individual samples or batches of data. Element 23 discusses this process.

There are several other flags associated with laboratory operations. See Appendix C for a complete list of data qualifiers/flags.

## 19.9 Filter-based PM10 Data Tracking

The DMS and other District software and hardcopy forms contain the information necessary to track and account for the whereabouts of filters and the status of data processing operations for specific data. The following data are used to track filter location and status:

- Laboratory
- Filter receipt (by lot)
- Filter pre-sampling weighing (individual filter number first enters the system)
- Filter packaged for the laboratory (filter numbers in each package are recorded)
- Laboratory
- Filter Chain-of-Custody (package is opened and filter numbers are logged in)
- Filter post-sampling weighing
- Filter archival

Tracking reports may be generated by any personnel with access to the District computer systems. The following information is available:

- Location of any filter (by filter number)
- List of all filters sent to a specified site that have not been returned
- List of all filters that have not been returned and are more than 30 days past initial weighing date
- List of all filters in the filter archive
- List of all filters that have been received but have not been post-weighed

The laboratory technician is responsible for tracking filter status at least once per week and following up on anomalies such as excessive holding time in the laboratory before reweighing.

## 19.10 Data and Filter Storage and Retrieval

Filter-based data and filter archive policies for the PM10 data are shown in Table 19.8.

**Table 19.8 Data and Filter Archive Policies**

| Data Type | Medium | Location | Retention Time | Final Disposition |
|---|---|---|---|---|
| Weighing records; chain of custody forms | Hardcopy | Laboratory | 5 years | Archived |
| Laboratory Notebooks | Hardcopy | Laboratory | 5 years | Archived |
| Field Notebooks | Hardcopy | Data Processing | 5 years | Archived |
| PM10 MP Data Base (excluding Audit Trail records) | Electronic (on-line) | District Main Office | indefinite (may be moved to backup media after 5 years) | Backup media retained indefinitely |
| PM10 MP Audit Trail records | Hardcopy | Data Processing | 5 years | Archived |
| Filters | Filters | Laboratory Freezer | 5 years | Archived |

Both filter-based and continuous TEOM PM10 data reside on at least two PC-compatible computers in the District's main office.

Security of data in the PM10 database is ensured by the following controls:

- Password protection on the database
- Storage of media including backup tapes in locked, restricted access areas

## 20.0 Assessments and Response Actions

An assessment, for this QAPP, is defined as an evaluation process used to measure the performance or effectiveness of the quality system, the establishment of the monitoring network and sites and various measurement phases of the data operation.

The results of quality assurance assessments indicate whether the control efforts are adequate or need to be improved. Documentation of all quality assurance and quality control efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can then consider the impact of these control efforts on the data quality (see Element 21). Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality and to what extent. Periodic assessments of SLAMS data quality are required to be reported to U.S. EPA. On the other hand, the selection and extent of the QA and QC activities used by a monitoring agency depend on a number of local factors such as the field and laboratory conditions, the objectives for monitoring, the level of the data quality needed, the expertise of assigned personnel, the cost of control procedures, pollutant concentration levels, etc.

In order to ensure the adequate performance of the quality system, US EPA Region IX, the California ARB, and the Great Basin Unified Air Pollution Control District (District) will perform the following assessments:

- Network Reviews
- Systems Audits
- Field and Laboratory Performance Audits
- Data Quality Assessments

## 20.1 Assessment Activities and Project Planning

### 20.1.1 Network Reviews

Conformance with network requirements of the Ambient Air Monitoring Network set forth in 40 CFR Part 58 Appendices D and E is determined through annual network reviews of the ambient air quality monitoring system. The network review is used to determine how well a particular air monitoring network is achieving its required air monitoring objective, and how it should be modified to continue to meet its objective. A PM10, meteorological, and sand flux Network review will be conducted every year. Since the U.S. EPA Regions are also required to perform these reviews, the District will coordinate its activity with the ARB and EPA Region IX in order to conduct the reviews at the same time, if possible.

The following criteria will be considered during the review:

- date of last review
- areas where attainment status is being reviewed
- results of special studies, e.g. saturation sampling, point source-oriented ambient monitoring, etc
- proposed network modifications since the last network review

In addition, pollutant-specific priorities may be considered (e.g., newly designated nonattainment areas, potential "problem areas", etc.).

Prior to the implementation of the network review, significant data and information pertaining to the review will be compiled and evaluated. Such information might include the following:

- network files (including updated site information and site photographs)
- AQS reports (AMP220, 225, 380, 390, 450)
- air quality summaries for the past five years for the monitors in the network
- emissions trends reports for dense population areas
- emission information, such as emission density maps for the region in which the monitor is located and emission maps showing the major sources of emissions
- National Weather Service summaries for monitoring network area

Upon receiving the information, it will be checked to ensure it is the most current available. Discrepancies will be noted on the checklist and resolved during the review. Files and/or photographs that need to be updated will also be identified. The following categories will emphasized during network reviews:

**Number of Monitors** - For SLAMS, the number of monitors required for PM10 depending upon the measurement objectives is discussed in 40 CFR Part 58 with additional details in the *Guidance for Network Design and Optimum Exposure for PM2.5 and PM10* . Element 10 of this QAPP discusses the PM10 Network. Adequacy of the network will be determined by using the following information:

- maps of historical monitoring data
- maps of emission densities
- dispersion modeling
- special studies/saturation sampling
- best professional judgment
- SIP requirements
- revised monitoring strategies (e.g., lead strategy, reengineering air monitoring network)

**Location of Monitors -** For SLAMS, the location of monitors is not specified in the regulations, but is determined by the EPA Regional Office, State, and/or Local agencies on a case-by-case basis to meet the monitoring objectives specified in 40 CFR Part 58, Appendix D. Adequacy of the location of monitors can only be determined on the basis of stated objectives. Maps, graphical overlays, and GIS-based information will be helpful in visualizing or assessing the adequacy of monitor locations. Plots of potential emissions and/or historical monitoring data versus monitoring locations will also be used.

During the network review, the stated objective for each monitoring location or site (see Element 10) will be assessed to confirm the suitability of the location and verify the spatial scale under which it is operating and, therefore, to determine whether these objectives can still be attained at the present location.

**Conformance to 40 CFR Part 58 Appendix E - Probe Siting Requirements** - Applicable siting criteria for SLAMS, and NCore stations are specified in 40 CFR Part 58, Appendix E. The on-site visit will consist of the physical measurements and observations to determine compliance with the Appendix E requirements, such as height above ground level, distance from trees, paved or vegetative ground cover, etc. Since many of the Appendix E requirements will not change within one year, this check at each site will be performed as part of a site survey each time the site is visited.

Prior to the site visit, the reviewer will obtain and review the following:

- most recent hard copy of site description (including any photographs)
- data on the seasons with the greatest potential for high concentrations for specified pollutants
- predominant wind direction by season

A checklist similar to the checklist used by the U.S. EPA Regional offices during their scheduled network reviews will be used. This checklist can be found in the *SLAMS/NAMS/PAMS Network Review Guidance,* which is intended to assist the reviewers in determining conformance with Appendix E. In addition to the items on the checklist, the reviewer will also perform the following tasks:

- ensure that the sampling inlet(s) is(are) clean
- check equipment for missing parts, frayed cords, damage, etc
- record findings in field notebook and/or checklist
- take photographs/videotape in 8 directions (at 45° intervals from North, clockwise)
- document site conditions, with additional photographs/videotape

**Other Discussion Topics** - In addition to the items included in the checklists, other subjects for discussion as part of the network review and overall adequacy of the monitoring program will include:

- installation of new monitors
- relocation of existing monitors
- siting criteria problems and suggested solutions
- any problems with data submittals and data completeness
- maintenance and replacement of existing monitors and related equipment
- quality assurance problems
- air quality studies and special monitoring programs
- other issues
    - proposed regulations
    - funding

A report of the network review will be written within two months of the review (Element 21) and appropriately filed (Element 10).

### 20.1.2 System Audits

A system audit is a thorough and systematic onsite qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP. The ARB's Quality Assurance Section (QAS) will conduct the system audit either as a team or as an individual auditor. The QAS will perform three system audit activities that can be accomplished separately or combined:

- Field - handling, sampling, shipping

- Laboratory - Pre-sampling weighing, shipping, receiving, post-sampling weighing, archiving, and associated QA/QC activities
- Data management - Information collection, flagging, data editing, security, upload

Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, laboratory operations, QA/QC, data management, and reporting. The audit activities are illustrated in Figure 20.1.

To ensure uniformity of the system audit, an audit checklist will be developed and used. Pertinent audit questions will appear on the audit checklist to ensure that the data collected at each stage maintains its integrity.

The audit team will discuss deficiencies with key personnel during the debriefing. They will be informed of any air quality data actions (AQDA) that will be issued for deficiencies that may require data invalidation.
The QAS will send a copy of the final system audit report to U.S. EPA Region IX. Any corrective action taken will be included in the report.

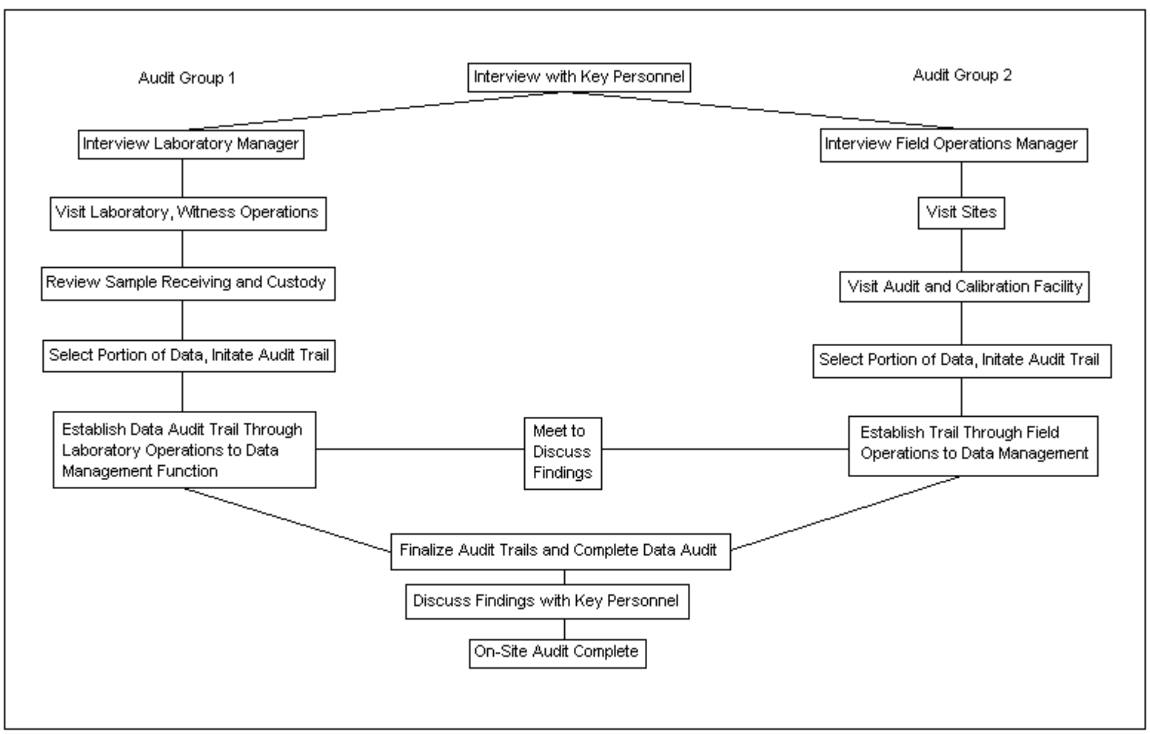


**Figure 20.1 Audit Activities**

**Post-Audit Activities** - The major post-audit activity is the preparation of the system audit report. The report will include:

- audit title and any other identifying information
- audit team leaders, audit team participants and audited participants
- background information about the project, purpose of the audit, dates of the audit, particular measurement phase or parameters that were audited, and a brief description of the audit process
- summary and conclusions of the audit and corrective action required
- attachments or appendices that include all audit evaluations and audit finding forms

To prepare the report, the audit team will meet and compare observations with collected documents and results of interviews and discussions with key personnel. Expected QA Project Plan implementation is compared with observed accomplishments and deficiencies and the audit findings are reviewed in detail. The system audit report will be submitted to the appropriate departments or agencies.

If the departments or agencies have written comments or questions concerning the audit report, the Audit Team will review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form following receipt of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

**Follow-up and Corrective Action Requirements** - The QAS and the audited organization may work together to solve required corrective actions. The audited organization has 30 days to respond to the follow-up and corrective action requirements in the system audit report. The QAS reviews the audited organization's responses to the follow-up and corrective action and works with the audited agency to resolve any discrepancies.

### 20.1.3 Field and Laboratory Performance Audits

Field and laboratory performance audits reveal how the data are handled, what judgments were made, and whether uncorrected mistakes were made. The audits can often identify the means to correct systematic data reduction errors. External performance audits are conducted annually by EPA IX contractors and/or ARB audit staff. Internal audits by the District audit staff are conducted quarterly for all PM monitoring systems and semiannually (approximately every six months) for all meteorological monitoring sensors Significant time and effort is devoted to this activity so that the external auditor or team has a clear understanding and complete documentation of the District's data flow. The audits serve as an effective framework for organizing the extensive amount of information gathered during the audit of laboratory, field monitoring, and support functions within the District. The performance audits have the same reporting/corrective action requirements as the system audits. All internal audit results are also posted to the AQS database.

### 20.1.4 Data Quality Assessment

A data quality assessment (DQA) is the statistical analysis of environmental data to determine whether the quality of data is adequate to support the decisions which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision based on the data is acceptable.

The District's Air Quality Data Review Committee has the responsibility to assess the data quality and the suitability of the monitoring network. These functions are done on an annual basis as required under 40 CFR Part 58. Data are processed through data screening programs to determine whether they are suitable for use in attainment/nonattainment decisions. Data flagged during this procedure are subject to further evaluation using statistical techniques to determine possible causes of anomalies. Results of these analyses are forwarded to data collection staff for confirmation of the validity of the data. If the data are shown to be invalid, Air Quality Data Review Committee staff will remove the data from all relevant databases. All changes to the data are to be documented in air quality data action reports.

Measurement uncertainty will be estimated for both automated and manual methods. Terminology associated with measurement uncertainty is found within 40 CFR Part 58, Appendix A, Sections 1, 3, and 4, and includes: (a) Precision - a measurement of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms of the standard deviation; (b) Accuracy - the degree of agreement between an observed value and an accepted reference value, accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations. The individual results of these tests for each method or analyzer shall be reported to U.S. EPA.

Estimates of the data quality will be calculated on the basis of single monitors and aggregated to all monitors.

## 20.2 Documentation of Assessments

Table 20.1 summarizes each of the assessments discussed above.

**Table 20.1 Assessment Summary**

| Assessment Activity | Frequency | Personnel Responsible | Schedule | Reporting/Resolution |
|---|---|---|---|---|
| Network Reviews<br>App D<br>App E | <br>1/ year<br>1/3 years | <br>GBUAPCD<br>GBUAPCD | <br>6/2013<br>6/2013 | GBUAPCD TO EPA & ARB |
| System Audits | 1/3 years | Quality Assurance Section - ARB | 2013 | MLD Quality Assurance Section to GBUAPCD |
| Field and Laboratory Performance Audits | 1/ year | Quality Assurance Section - ARB | annual | MLD Quality Assurance Section to GBUAPCD |
| Field and Laboratory Performance Audits | 4/ year | Quality Assurance Auditor - GBUAPCD | quarterly | GBUAPCD Auditor to GBUAPCD Air Monitoring Specialist |
| Data Quality Assessment | 1/year | GBUAPCD-Data Review Committee | 6/2001 | GBUAPCD to U.S. EPA Region IX & ARB |

## 21.0 Reports to Management

This Element describes the quality-related reports and communications to management necessary to support SLAMS PM10, meteorological, and sand flux monitoring network operations and the associated data acquisition, validation, assessment, and reporting activities.

Important benefits of regular QA reports to management include the opportunity to alert the management of data quality problems, to propose viable solutions to problems, and to procure necessary additional resources. Quality assessments, including the evaluation of the technical systems, the measurement of performance, and the assessment of data, are conducted to help insure that measurement results meet program objectives and that necessary corrective actions are taken early, when they will be most effective.

Effective communication among personnel is an integral part of a quality system. Regular, planned quality reporting provides a means for tracking the following:

- adherence to scheduled delivery of data and reports,
- documentation of deviations from approved QA and test plans, and the impact of these deviations on data quality
- analysis of the potential uncertainties in decisions based on the data

### 21.1 Frequency, Content, and Distribution of Reports

Required reports to management for PM10 monitoring and the SLAMS program in general are discussed in 40 CFR Part 58, Appendix A, Section 5. Guidance for management report format and content are provided in guidance developed by U.S. EPA's Quality Assurance Division (QAD) and the Office of Air Quality Planning and Standards (OAQPS). These reports are described in the following sub-elements.

#### 21.1.1 Network Reviews

As required by 40 CFR Part 58 Appendix A, Section 5, the District has assembled a list of all monitoring sites and their AQS site identification codes and submitted the list to the U.S. EPA Region IX Office, with a copy to the Air Quality Subsystem (AQS). Whenever there is a change in this list of monitoring sites in a reporting organization, the will report this change to the U.S. EPA Region IX Office, to AQS, and to ARB’s MLD Quality Assurance Section and TSD Air Quality Data Review Section.

#### 21.1.2 Quarterly Reports

Each quarter, the District will report to AQS the results of all precision and accuracy tests carried out during the quarter. The quarterly reports will be submitted, consistent with the data reporting requirements specified for air quality data as set forth in 40 CFR Parts 58.26, 58.35, and 40 CFR Part 58, Appendix A, Section 4.

The data reporting requirements of 40 CFR Parts 58.28 and 58.35 apply to those stations designated SLAMS or NCore. Required accuracy and precision data are to be reported on the same schedule as quarterly monitoring data submittals. The required reporting periods and due dates are listed in Table 21-1.

**Table 21-1 Quarterly Reporting Schedule**

| Reporting Period | Due on or Before |
|---|---|
| January 1-March 31 | June 30 |
| April 1-June 30 | September 30 |
| July 1-September 30 | December 31 |
| October 1-December 31 | March 31 (following year) |

Air quality data submitted for each reporting period will be edited, validated, and entered into AQS using the procedures described in the *AIRS/AQS Users Guide, Volume II, Air Quality Data Coding.* The District's Technical Services Group and Data Processing Group will be responsible for preparing the data reports, which will be reviewed by the Air Monitoring Specialist and the Senior Systems Analyst before they are transmitted to U.S. EPA.

### 21.1.3 System and Performance Audit Reports

The ARB conducts system audits of the District's monitoring system (Element 20). These reports are issued by the ARB MLD Quality Assurance Section Manager and are reviewed by the ARB/MLD Quality Management and Operations Support Branch Chief and the MLD Chief. These reports will be filed and made available to the U.S. EPA.

External system audits are to be conducted at least every three years by the U.S. EPA Regional Office as required by 40 CFR Part 58, Appendix A, Section 2.5. Further instructions are available from either the U.S. EPA Regional QA Coordinator or the System Audit QA Coordinator, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division (MD-14), United States Environmental Protection Agency, Research Triangle Park, NC 27711.

### 21.1.4 Air Quality Data Action Request

An Air Quality Data Action (AQDA) request or notification is issued by the ARB or the District whenever a problem is found with the monitoring operation or a failure to comply with procedures is discovered, which could have an effect on data quality. The AQDA request or notification is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities that can be used in preparing other summary reports.

The AQDA request procedure is designed as a closed-loop system. The AQDA request form identifies the originator, who reported and identified the problem, states the problem, and may suggest a solution. The form also indicates the name of the person(s) who is assigned to correct the problem. The assignment of personnel to address the problem and the schedule for completion will be determined by the appropriate supervisor. The AQDA request procedure closes the loop by requiring that the recipient state on the form how the problem was resolved and what disposition to take with the data (accept, correct, invalidate). Copies of the AQDA request will be distributed twice: first, when the problem has been identified and the action has been scheduled; and second, when the correction has been completed. The originator, the District's Air Monitoring Specialist, the field or laboratory supervisor, ARB branch chiefs, and the ARB QA Section Manager will be included in the distributions where applicable.

### 21.1.5 Calibration Summaries

Calibration summaries for laboratory instruments are updated after every new calibration or standardization as defined in the relevant SOP. Control charts can be generated from these data, should the need arise. Analysts are responsible for reviewing these data immediately after they are collected and for taking corrective actions whenever out-of-specification conditions are observed. Calibration reports are to be reviewed at least quarterly by the laboratory supervisor. The laboratory technician will provide quarterly summary information to the District QA Technician and to the Air Monitoring Specialist. Calibration data are also subject to inspection during audits, and laboratory personnel are responsible for maintaining a readily-accessible file of calibration summaries for each instrument.

## 21.2 Responsible Personnel

This Element outlines the responsibilities of individuals within the monitoring organization for preparing quality reports, evaluating their impact, and implementing follow-up actions. Changes made in one area or procedure may affect another part of the project. Only by defining clear-cut lines of communication and responsibility can all the affected elements of the monitoring network remain current with such changes. The documentation for all changes will be maintained and included in the reports to management. The following paragraphs describe key personnel involved with QA reporting.

**Air Pollution Control Officer**

The District Air Pollution Control Officer is ultimately responsible for the quality of the data and the technical operation of the particulate monitoring network. The responsibilities for overseeing the air quality data collection and reporting activities are delegated to the Deputy Air Pollution Control Officer, the Director of Technical Services, the Senior Systems Analyst, and the Air Monitoring Specialist.

**Deputy Air Pollution Control Officer, Director of Technical Services**

The Deputy Air Pollution Control Officer and Director of Technical Services are responsible for the data collected from all PM10 monitors in the District’s monitoring network. These responsibilities include defining and implementing the document management and quality assurance systems for the PM10 monitoring network. The responsibility for the collection, validation, and submission of the data collected from all PM10 monitors is delegated by the Management Staff to the Air Monitoring Specialist and the Senior Systems Analyst. The responsibility for the submittal of all relevant reports is also delegated to the Air Monitoring Specialist and the Senior Systems Analyst.

**Air Monitoring Specialist, Air Monitoring Technical Specialist**

The Air Monitoring Specialist and the Air Monitoring Technical Specialist oversee the day-to-day activities associated with the PM10 monitoring program, including the operation, maintenance, and repair of any PM10 monitors in the District. They submit all relevant reports to the Management Staff as necessary. The Air Monitoring Specialist and the Air Monitoring Technical Specialist are also responsible for the precision and accuracy of all data generated and collected by the District. These positions serves as one part of the effort to assure that the data are in compliance with the criteria set by Federal and State Clean Air Acts. These responsibilities are carried out by conducting field performance and system audits, issuing recommendations for data adjustment on instruments, evaluating potential air monitoring sites, and issuing reports on audit results.

**Quality Assurance Technician**

The Quality Assurance Technician is responsible for the District's internal audit program. These responsibilities include audits of all particulate monitors, meteorological sensors, etc., operated within the District. Audit reports are generated and provided to the monitoring staff and the Air Monitoring Specialist as a "third-party" check on the operation of the monitoring equipment used throughout the District.

**Air Monitoring Technicians**

Air Monitoring Technicians are responsible for the calibration, operation, and maintenance of the monitoring equipment and for the gathering of the data collected by that monitoring equipment. They are not normally responsible for authoring reports to management, however, they participate in the process by identifying the need for data adjustments and maintaining other quality-related information used to prepare District QA reports and ARB QA reports.

**Laboratory Technician**

The District Laboratory Technician is responsible for authoring appropriate sections of quarterly QC reports to management. The technician generates spreadsheets and charts, identifies the need for data adjustments, and maintains other quality-related information used to prepare QA and QC reports. The technician also assembles and prepares the quarterly laboratory report for submission to the air monitoring specialist and the ARB as necessary.

**Senior Systems Analyst/Systems Analyst II**

The District's Senior Systems Analyst and the data processing staff carefully manage, archive, and distribute the ambient aerometric data collected on behalf of the District's air quality management programs. Specific activities include resolving discrepancies in data, providing for the orderly and efficient transfer of data from data suppliers to the District and the EPA AQS database, and distributing the data to meet customer needs. Further specific duties include the development and implementation of enhancements to the data management systems and to the forms of data distribution. The analyst and the data processing staff are also involved in the evaluation of siting issues, including annual network reviews for PM10 and other parameters.

## 22.0 Data Review, Validation and Verification Requirements

This element describes how the Great Basin Unified APCD will verify and validate the data collection operations associated with the PM10, meteorological, and sand flux monitoring network.

Verification can be defined as confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation can be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Although there are a number of objectives for collection of ambient air data, the major objective for the GBUAPCD PM10 network is for comparison to the NAAQS and therefore, this will be identified as the intended use. This element will describe the verification and validation activities that occur at a number of the important data collection phases. Earlier elements of this QAPP describe in detail how the activities in these data collection phases will be implemented to meet the data quality objectives of the program. Review and approval of this QAPP by the ARB and U.S. EPA Region IX provide initial agreement that the processes described in the QAPP, as implemented, will provide data of adequate quality. In order to verify and validate the phases of the data collection operation, the District will use various qualitative assessments (e.g., system audits, network reviews) to verify that the QAPP is being followed, and will rely on the various quality control samples, inserted at various phases of the data collection operation, to validate that the data will meet the DQOs described in Element 7.

Additional objectives for the PM10, meteorological, and sand flux monitoring networks in the District include determining dust source areas and quantifying their contribution(s) to exceedances of the PM10 NAAQS in a given non-attainment area.

### 22.1 Sampling Design

The monitoring network description for the District is contained in four documents that cover the sub-networks mentioned in Element 10. These documents are the Air Quality Management Plan for the Town of Mammoth Lakes, November 30, 1990; the Reasonable Further Progress Report for the Mono Basin PM-10 State Implementation Plan, September 2010; the Owens Valley PM10 Planning Area Demonstration of Attainment State Implementation Plan, January 28, 2008; and the Coso Junction PM10 Maintenance Plan, May 18, 2010. All of these documents have been submitted to EPA IX and they describe the PM10 monitoring network designed by the District. These documents cover the number of sites required for each sub-network, their locations, and the frequency of data collection. The objective of the sampling design is to represent the populations of interest at adequate levels of spatial and temporal resolution. Most of these requirements are described in the Code of Federal Regulations. However, it is the responsibility of the District to ensure that the intent of these regulations is properly administered and carried out.

#### 22.1.1 Sampling Design Verification

Verification of the sampling design is accomplished through three processes:

**Network Design Plan Confirmation** - The Network Design Plan that discusses the deployment of the network must be submitted, reviewed and approved by U.S. EPA Region IX annually. This process verifies the initial sampling design.

**Internal Network Reviews** - At least once each year, the District's Air Quality Management Staff will perform a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the Federal siting criteria (see Element 20).

**External Network Reviews** - Every three years the U.S. EPA Region IX Office and/or the ARB Quality Assurance Section will conduct a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the Federal siting criteria.

### 22.1.2 Sampling Design Validation

The ambient air monitoring data collected from the sites will be used to validate the sampling design. For the Owens Lake and Mono Lake Dust ID networks, one part of this process involves using the sand flux data from the lakebed areas to run a model which predicts concentrations at the monitoring stations. This information will be included in the network review documentation and appropriately communicated to the U.S. EPA Region IX Office. In addition, the processes described in Element 10 will be used to confirm the network design.

## 22.2 Sample Collection Procedures

### 22.2.1 Sample Collection Verification

Sample collection procedures are described in detail in Element 11 and are developed to ensure proper sampling and handling to maintain sample integrity. The following processes will be used to verify the sampling collection activities:

**System Audits** - System audits will be conducted, as described in Element 20.1.2, to verify that the sample collection activity is being performed as described in this QAPP and the SOPs. Deviations from the sample collection activity will be noted in audit finding forms and corrected using the procedures described in Element 20.

### 22.2.2 Sample Collection Validation

The sample collection activity is just one phase of the measurement process. The use of QC samples that have been placed throughout the measurement process can help validate the activities at each phase. The review of QC data such as the collocated sampling data, field blanks, the sampler performance evaluation, and the sampling equipment verification checks that are described in Elements 14 and 16 can be used to validate the data collection activities. Any data that indicates unacceptable levels of bias or precision or a tendency to drift will be flagged and investigated.

## 22.3 Sample Handling

Elements 11, 12, and 17 detail the requirements for sample handling, including the types of sample containers and the preservation methods used to ensure that the samples are appropriate to the nature of the sample and the type of data generated from the sample. Due to the size of the filters and the nature of the collected particles, sample handling is one of the phases where inappropriate technique can have a significant effect on sample integrity and data quality.

### 22.3.1 Verification of Sample Handling

As mentioned above, system audits will be performed to ensure the specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample (e.g., proper labeling and chain-of-custody records), packaging in the field, and proper storage conditions (e.g., chain-of-custody and storage records) to ensure that the sample continues to be representative of its native environment as it moves through the data collection process.

### 22.3.2 Validation of Sample Handling

Similar to the validation of sampling activities, the review of data from collocated sampling, field blanks, and the FRM performance evaluations, that are described in Elements 14 and 16 can be used to validate the sample handling activities. Acceptable precision and bias in these samples would confirm that the sample handling techniques are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency to drift will be flagged and investigated.

## 22.4 Analytical Procedures

Element 13 details the requirements for the analytical methods, which include the pre-sampling weighing activities that give each sample a unique identification, an initial weight, and preparation for the field. Also included are the post-sampling weighing activities, which provide the final and hence, the net weight, and the final concentration calculations. The methods include acceptance criteria (Elements 13 and 14) for important components of the procedures, along with suitable codes for characterizing each sample's deviation from prescribed procedure.

### 22.4.1 Verification of Analytical Procedures

As mentioned above, system audits will be performed to ensure the analytical method specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample. Deviations from the analytical procedures will be noted in audit finding forms and corrected using the procedures described in Element 20.

### 22.4.2 Validation of Analytical Procedures

Similar to the validation of sampling activities, the review of data from lab blanks, calibration checks, laboratory duplicates and other laboratory QC activities that are described in Elements 14 and 16 can be used to validate the analytical procedures. Acceptable precision and bias in these samples would indicate that the analytical procedures are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency to drift will be flagged and investigated as described in Element 14.

## 22.5 Quality Control

Elements 14 and 16 of this QAPP specify the QC checks that are to be performed during sample collection, handling, and analysis. These include analyses of mass standards, filter blanks, spikes, and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each specified QC check, the procedure, acceptance criteria, and corrective action are specified.

**22.5.1 Verification of Quality Control Procedures**

As mentioned above, system audits will be performed to ensure the quality control method specifications mentioned in the QAPP are being followed.

**22.5.2 Validation of Quality Control Procedures**

Validation activities of many of the other data collection phases mentioned in this sub-element use the quality control data to validate the proper and adequate implementation of that phase. Therefore, validation of QC procedures will require a review of the documentation of the corrective actions that were taken when QC samples failed to meet the acceptance criteria, and the potential effect of the corrective actions on the validity of the routine data. Element 14 describes the techniques used to document QC review/corrective action activities.

**22.6 Calibration**

Element 16, as well as the field (Element 11) and the analytical elements (Element 13) detail the calibration activities and requirements for the critical pieces of equipment for the PM10 monitoring network.

**22.6.1 Verification of Calibration Procedures**

As mentioned above, system audits will be conducted to ensure the calibration specifications and corrective actions mentioned in the QAPP are being followed. Deviations from the calibration procedures will be noted in audit finding forms and corrected using the procedures described in Element 20.

**22.6.2 Validation of Calibration Procedures**

Similar to the validation of sampling activities, the review of calibration data that are described in Elements 14 and 16, can be used to validate calibration procedures. Calibration data within the acceptance requirements indicate that the sample collection measurement devices are operating properly. Any data that indicates unacceptable levels of bias or precision or a tendency to drift will be flagged and investigated as described in Elements 14 or 16. Validation would include the review of the documentation to ensure corrective action was taken as prescribed in the QAPP.

**22.7 Data Reduction and Processing**

**22.7.1 Verification of Data Reduction and Processing Procedures**

As mentioned above, system audits will be conducted to ensure the data reduction and processing activities mentioned in the QAPP are being followed.

### 22.7.2 Validation of Data Reduction and Processing Procedures

The District's QA staff will conduct the validation process. As part of the audits of data quality, discussed in Element 20.1.4, a number of sample IDs chosen at random will be identified. All raw data files, including the following will be selected:

- Presampling weighing activity
- Presampling activities and environment
- Sampling activity and sampler data download
- Sampler calibration in effect during sampling period
- Postsampling handling, storage, and transport to lab
- Postsampling storage and weighing by lab
- Corrective action procedures
- Data reduction and entry

These raw data will be reviewed and final concentrations will be calculated by hand to determine whether the final values submitted to AQS compare favorably with the hand calculations. These values are generally within 1% and will be investigated if they differ by 3% or more. The data will also be reviewed to ensure that associated flags or any other data qualifiers have been appropriately associated with the data and that appropriate corrective actions were taken.

## 23. Validation and Verification Methods

Many of the processes for verifying and validating the measurement phases of the PM10 data collection operation have been discussed in Element 22. If these processes, as written in this QAPP are followed and the monitoring sites are representative of the boundary conditions for which they were selected, then the PM10, Meteorological, and Sand Flux Monitoring Data Quality Objectives (DQOs) should be achieved. Exceptional field events may occur, however, and field and laboratory activities may adversely affect the integrity of the samples. Additionally, it is expected that some of the QC checks will fail to meet the acceptance criteria. Information on problems that affect the integrity of the data is identified in the form of data qualifiers or flags (Appendix C). It is important to determine how and whether these failures affect the routine data. The review of these routine data and their associated QC data will be verified and validated. It is assumed that if measurement uncertainty will be maintained within the precision and bias DQOs, then the program objectives will be met.

### 23.1 Process for Validating and Verifying Data

#### 23.1.1 Verification of Samples

After a sample batch is processed in the laboratory, a thorough review of the data for completeness and data entry accuracy will be conducted. All raw data that are entered by hand on the data sheets will be entered into the spreadsheet as discussed in Element 19. The entered data are compared with the data forms to minimize transcription errors. The spreadsheet will then flag all data that fall outside the acceptance criteria. The flagged data will be reviewed and reassessed. Details of these activities are discussed in Element 19. The data qualifiers or flags are listed in Appendix C.

#### 23.1.2 Validation

Validation of measurement data will be conducted on three levels: one at the measurement value level, a second at the batch level, and a third at the instrument level. Records of all invalid samples will be filed. Information will include a brief summary of the reason(s) for invalidating the sample along with the associated flags. A portion of this record will be available on the spreadsheet since all filters that are pre-weighed will be recorded whether or not the sample is valid. At least one flag will be associated with an invalid sample, that being the “INV” flag signifying invalidation. Additional flags will usually be associated with the INV flag that help explain the reason for this flag. Free form notes from the field operator or laboratory technician may also be included.

**Validation of Measurement Values**

Certain criteria based upon Title 40 CFR, U.S. EPA QA Guidance Documents 2.10, 2.11, 2.11, EPA QA Handbook Volume IV, EPA OTM-30, and field operator and laboratory technician judgment have been developed that will be used to determine whether individual samples or samples from a particular instrument will be invalidated. In all cases the samples will be returned to the laboratory for further examination. When the laboratory technician reviews the field sheet and chain-of-custody forms he or she will look for flag values. Samples that are flagged for obvious contamination, filter damage, or field accidents will immediately be examined. Upon concurrence of the laboratory technician and the laboratory supervisor, these samples will be invalidated.

Other flags listed in Appendix C may be used alone or in combination to invalidate samples. Since the possible flag combinations cannot be anticipated, the District will review these flags and determine whether single values or values from a site for a particular time period will be invalidated. The District will keep a record of the combination of flags that resulted in invalidating a sample or set of samples. These combinations will be reported to EPA Region IX and the ARB and will be used to ensure that the District evaluates and invalidates data consistently from one batch to the next. These combinations will be programmed into the validation system in order to assist the laboratory in evaluating data. As mentioned above, all data invalidation will be documented. Table 23-1 contains criteria that can be used to invalidate single samples based on single flags.

**Table 23-1 Single Flag Invalidation Criteria for Single Samples**

| Requirement | Flag | Comment |
|---|---|---|
| Contamination | CNTM | Concurrence with lab technician and lab manager |
| Filter Damage | DMG | Concurrence with lab technician and lab manager |
| Event | See Table C-3 | Exceptional, known field event expected to have affected sample Concurrence with lab technician and lab manager |
| Laboratory Accident | LABA | Concurrence with lab technician and lab manager |
| Field Accident | FLDA | Concurrence with lab technician and lab manager |
| Flow Rate Cutoff | FLOW | Termination of sample collection due to flow rate > 10% design flow rate for 60 seconds. |

Due to the nature and holding times of the routine samples, it is critical that the District minimize the amount of data invalidated. Therefore, the District will validate data on single samples, sample batches, and groups of samples from one instrument. Based on the types of QC samples that are included and the field and laboratory conditions that are reported (field/lab flags), the ARB, in conjunction with the national PM10 Data Validation Workgroup, has developed a validation template that is used to determine when routine data will be invalidated and when major corrective actions need to be instituted. Tables 23-2, 23-3, and 23-4 represent the validation template.

Table 23-2 lists those requirements that are critical and must be met. Table 23-3 lists the recommendations that should be met. In instances where acceptance criteria in Table 23-3 are not met, the District will investigate and take corrective action. Data that do not meet these criteria will not necessarily be invalidated. Table 23-4 lists those requirements that should also be met but are of a systemic nature. Data will not necessarily be invalidated if the criteria in Table 23-4 are not met.

## Table 23-2 Parameter PM10-Critical Frequency and Acceptance Criteria Defined in CFR

| Requirement | Frequency | Acceptance Criteria |
|---|---|---|
| ***Sampling Period*** | All data | 1380 - 1500 minutes or<br>if <1380 and exceedance of NAAQS |
| ***Sampling Instrument*** | | |
| Flow Rate | every 24 hours of operation | ≤ ±10% of 16.67 lpm |
| ***Filter*** | | |
| Visual Defect Check | All filters | See QA Guidance Document 2.10, Sec. 4.2 |
| Filter Conditioning Environment | | |
| Equilibration | All filters | 24 hours minimum |
| Temp. Range | " | 24-hr mean 15-30°C |
| Temp. Control | " | ±3°C standard deviation over 24 hrs |
| Humidity Range | " | 24-hr mean 20-45% RH |
| Humidity Control | " | ±5% standard deviation over 24 hrs. |
| Pre/post sampling RH | " | ±5% RH |
| Balance | " | located in filter conditioning environment |

## Table 23-3 Parameter PM10 - Operational Evaluation Indicators

| Requirement | Frequency | Acceptance Criteria |
|---|---|---|
| ***Reporting Units*** | All data | μg/m$^3$ |
| ***Detection Limit*** | | |
| Lower DL | All data | 2 μg/m$^3$ (estimated) |
| Upper Conc. Limit | All data | 30000 μg/m$^3$ (estimated) |
| ***Filter Checks*** | | |
| Lot Blanks | 3 filters per lot | < 15μg change between weighings |
| Exposure Lot Blanks | 3 filters per lot | < 15μg change between weighings |
| ***Lab QC Checks*** | | |
| Field Filter Blank | 10% or 1 per weighing session | ± 60μg change between weighings |
| Lab Filter Blank | 10% or 1 per weighing session | ± 15μg change between weighings |
| Balance Check | beginning, end of weighing session | ≤ 3μg |
| Duplicate Filter Weighing | Reweigh 1 per every 10 filters | ± 20μg change between weighings |
| ***Calibration/Verification*** | | |
| Flow Rate (FR) multipoint calibration | 2/yr or if verification failure | **± 4% of transfer standard** |
| FR single-point Verification | 1/4 weeks | **± 7% of transfer standard and ±10% of design flow rate** |

## Table 23-4 Parameter PM10 - Systematic Issues

| Requirement | Frequency | Acceptance Criteria |
|---|---|---|
| ***Data Completeness*** | **quarterly** | **75%** |
| ***Accuracy***<br>FRM Performance Evaluation | **25% of sites 4/yr** | **±10%** |
| ***Precision***<br>Collocated Samples<br>Single Analyzer<br>Single Analyzer<br>Reporting Org. | **Every 12 days for collo. sites**<br>**1/3 months**<br>**1/year**<br>**1/3 months** | **CV ≤ 25%**<br>**CV ≤ 10%**<br>**CV ≤ 10%**<br>**CV ≤ 25%** |
| ***Calibration & Check Standards***<br>Flow Rate Transfer Std. | **1/year** | **± 2% of NIST-traceable std.** |

The samples will be evaluated and a report generated based on the results of validation. If the report indicates invalidation of data, those samples will be reanalyzed and reevaluated. All efforts will be made to take whatever corrective actions are necessary to correct the problem. If, after this secondary or Level II validation, the samples still remain outside the applicable criteria, the samples will be flagged as invalid (INV), depending on the specific acceptance criteria.

# 24. Reconciliation with Data Quality Objectives

## 24.1 Reconciling Results with DQOs

The DQOs for the PM10 ambient air monitoring network were developed in Element 7. The resulting DQOs are for precision, as measured by a coefficient of variation, to be less than 10% and for relative bias to be between -10% and +10%. This section of the QAPP will outline the procedures that the District will follow to determine whether the monitors and laboratory analyses are producing data that comply with the DQOs and what action will be taken as a result of the assessment process. Such an assessment is termed a Data Quality Assessment (DQA) and is described in *EPA QA/G-9: Guidance for Data Quality Assessment*[2]. An assessment of the quality of the data will be made at the site level as well as at the District level.

### 24.1.1 Five Steps of Data Quality Assessment Process

As described in *EPA QA/G-9*, the DQA process is comprised of five steps which are detailed below.

**Step 1. Review DQOs and Sampling Design**.
Element 7 of this QAPP contains the details for the development of the DQOs, including defining the primary objective of the PM10 ambient air monitoring network (PM10 NAAQS comparison), translating the objective into a statistical hypothesis: 3-year average of annual exceedances of the PM10 24-hour standard concentration less than or equal to 1 occurrence per year), and developing limits on the decision errors (incorrectly conclude area in non-attainment when it truly is in attainment no more than 5% of the time, and incorrectly conclude area in attainment when it truly is in non-attainment no more than 5% of the time).

Element 10 of this QAPP contains the details for the sampling design, including the rationale for the design, the design assumptions, and the sampling locations and frequency. If any deviations from the sampling design have occurred, these will be indicated and their potential effect carefully considered throughout the entire DQA.

**Step 2. Conduct Preliminary Data Review.** A preliminary data review will be performed to uncover potential limitations to using the data, to reveal outliers, and generally to explore the basic structure of the data. The first step is to review the quality assurance reports. The second step is to calculate basic summary statistics, generate graphical representations of the data, and review these summary statistics and graphs.

*Review Quality Assurance Reports*. The District will review all relevant quality assurance reports that describe the data collection and reporting process. Particular attention will be directed to looking for anomalies in recorded data, missing values, and any deviations from standard operating procedures. This is a qualitative review. However, any concerns will be further investigated in the following two steps.

*Calculation of Summary Statistics and Generation of Graphical Representations*. The District will generate some summary statistics for each of its primary and QA samplers. The summary statistics will be calculated at the quarterly, annual, and three-year levels and will include only valid samples. The summary statistics are:

Number of samples,
Mean concentration,
Median concentration,
Standard deviation,
Coefficient of variation,
Maximum concentration,
Minimum concentration,
Interquartile range,
Skewness, and
Kurtosis.

These statistics will also be calculated for the percent differences at the collocated sites. The results will be summarized in a table. Particular attention will be given to the impact on the statistics caused by the observations noted in the quality assurance review. In fact, the District may evaluate the influence of a potential outlier by evaluating the change in the summary statistics resulting from exclusion of the outlier.

The District will generate some graphics to present the results from the summary statistics and to show the spatial continuity over the District. Maps will be created for the annual and three-year means, maxima, and interquartile ranges for a total of 6 maps. The maps will help uncover potential outliers and will help in the network design review. Additionally, basic histograms will be generated for each of the primary and QA samplers and for the percent difference at the collocated sites. The histograms will be useful in identifying anomalies and evaluating the normality assumption in the measurement errors.

**Step 3. Select the Statistical Test.** The primary objective for the PM10 monitoring is determining whether an area is in compliance with the PM10 NAAQS. As a result the number of exceedances per year can be calculated for areas monitoring on a schedule that is less than daily. The District operates monitors for PM10 on a daily schedule and, as such, all exceedances are monitored, therefore no statistical test is needed to determine the number of exceedances that might occur in a particular quarter or year.

**Step 4. Verify Assumptions of Statistical Test.** The assumptions behind the statistical test include those associated with the development of the DQOs in addition to the bias and precision assumptions. Their method of verification will be addressed in this step. Note that when less than three years of data are available, this verification will be based on as much data as are available.

*The DQO is based on the annual arithmetic mean NAAQS*. For each primary sampler, the District will determine whether the PM10 NAAQS is violated. Conceptually, the DQOs can be developed based on the 24-hour NAAQS and the more restrictive bias and precision limits selected. The District will assume the 24-hour standard is most restrictive, until proven otherwise.

*Normal distribution for measurement error*. Assuming that measurement errors are normally distributed is common in environmental monitoring. The District has not investigated the sensitivity of the statistical test to violation of this assumption; although, small departures from normality generally do not create serious problems. The District will evaluate the reasonableness of the normality assumption by reviewing a normal probability plot, calculating the Shapiro-Wilk W test statistic (if sample size less than 50), and calculating the Kolmogorov-Smirnoff test statistic (if sampler size greater than 50). All three techniques are provided by standard statistical packages and by the statistical tools provided in *EPA QA/G-9D: Data Quality Evaluation Statistical Tools1(DataQUEST)*. If the plot or statistics indicate possible violations of normality, the District may need to determine the sensitivity of the DQOs to departures in normality.

*Decision error can occur when the estimated 3-year average differs from the actual, or true, 3-year average*. This is not really an assumption as much as a statement that the data collected by an ambient air monitor is stochastic, meaning that there are errors in the measurement process, as mentioned in the previous assumption.

*The limits on precision and bias are based on the smallest number of required sample values in a 3-year period.* In the development of the DQOs, the smallest number of required samples was used. The reason for this was to ensure that the confidence was sufficient in the minimal case; if more samples are collected, then the confidence in the resulting decision will be even higher. For each of the samplers, the District will determine how many samples were collected in each quarter. If this number meets or exceeds 12, then the data completeness requirements for the DQO are met.

*The decision error limits were set at 5%.* Again, this is more of a statement. If the other assumptions are met, then the decision error limits are less than or equal to 5%.

*Measurement imprecision was established at 10% coefficient of variation (CV)*. For each sampler, the District will review the coefficient of variation calculated in Step 2. If any exceed 10%, the District may need to determine the sensitivity of the DQOs to larger levels of measurement imprecision.

Table 24.1 will be completed during each DQA. The table summarizes which, if any, assumptions have been violated. A check will be placed in each of the row/column combinations that apply. Ideally, there will be no checks. However, if there are checks in the table, the implication is that the decision error rates are unknown even if the bias and precision limits are achieved. As mentioned above, if any of the DQO assumptions are violated, then the District will need to reevaluate its DQOs.

**Table 24-1. Summary of Violations of DQO Assumptions**

| Site | Violate 24-Hour Standard ONLY? | Measurement Errors Non-Normal? | Data Complete? ( 12 samples per quarter) | Measurement CV > 10%? |
|---|---|---|---|---|
| Primary Samplers | | | | |
| A1 | | | | |
| A2 | | | | |
| A3 | | | | |
| A4 | | | | |
| B1 | | | | |
| QA Samplers | | | | |
| A1 | | | | |
| B1 | | | | |

*Achievement of bias and precision limits*. Lastly, the District will check the assumption that at the three-year level of aggregation the sampler bias is within 10% and precision is less than 10%. The data from the collocated samplers will be used to estimate quarterly, annual, and three-year bias and precision estimates even though it is only the three-year estimates that are critical for the statistical test.

Since the samplers being deployed by the District will be a mix of reference and equivalent method monitors, the samplers at some of the collocated sites will be identical method designations (e.g. Sequential Partisols) and others will be of a different method designation (Sequential Partisols collocated with TEOMs). As such it will be helpful to use these data to determine which of the collocated samplers is closer to the “true” PM concentration. The District will calculate an estimate of precision. A bias measure will also be calculated to describe the relative difference of one sampler to the other. The monitor bias can also indicate which sampler is more “true.” Algorithms for calculating precision and bias are described below. These are similar, but differ slightly, from the equations in 40 CFR Part 58 Appendix A. These have been developed with assistance from OAQPS/EMAD.

Before describing the algorithm, first some ground work is in order. When less than three years of collocated data are available, the three-year bias and precision estimates must be predicted. The District’s strategy for accomplishing this will be to use all available quarters of data as the basis for projecting where the bias and precision estimates will be at the end of the three-year monitoring period. Three-year point estimates will be computed by weighting the quarterly components, using the most applicable of the following assumptions:

1. Most recent quarters precision and bias are most representative of what the future quarters will be.
2. All previous quarters precision and bias are equally representative of what the future quarters will be.
3. Something unusual happened in the most recent quarter, so the most representative

quarters are all the previous ones, minus the most recent.

Each of these scenarios results in weights that will be used in the following algorithms. The weights are shown in Table 24.2 where the variable $Q$ represents the number of quarters for which observed bias and precision estimates are available. Note that when $Q$=12, that is, when there are bias and precision values for all of the quarters in the three-year period, then all of the following scenarios result in the same weighting scheme.

**Table 24-2. Weights for Estimating Three-Year Bias and Precision**

| Scenario | Assumption | Weights |
|---|---|---|
| 1 | Latest quarter most representative | $w_q$ = 12-($Q$-1) for latest quarter,<br>$w_q$ = 1 otherwise |
| 2 | All quarters equally representative | $w_q$ = 12/$Q$ for each quarter |
| 3 | Latest quarter unrepresentative | $w_q$ = 1 for latest quarter,<br>$w_q$ = 11/($Q$-1) otherwise |

In addition to point estimates, the District will develop confidence intervals for the bias and precision estimates. This will be accomplished using a re-sampling technique. The protocol for creating the confidence intervals is outlined below.

**Method for Estimating Confidence in Achieving Bias and Precision DQOs**
Let $Z$ be the statistic of interest (bias or precision). For a given weighting scenario, the resampling will be implemented as follows:

1. Determine $M$, the number of collocated pairs per quarter for the remaining 12-$Q$ quarters (default is $M$=15 or can use $M$=average number observed for the previous $Q$ quarters.
2. Randomly select with replacement $M$ collocated pairs per quarter for each of the future 12-$Q$ quarters in a manner consistent with the given weighting scenario.
   Scenario 1: Select pairs from latest quarter only.
   Scenario 2: Select pairs from any quarter.
   Scenario 3: Select pairs from any quarter except the latest one.
   Result from this step is "complete" collocated data for a three-year period, from which bias and precision estimates can be determined.
3. Based on the "filled-out" three-year period from step 2, calculate three-year bias and precision estimate, using Equation 1 where $w_q$ = 1 for each quarter.
4. Repeat steps 2 and 3 numerous times, such as 1000 times.
5. Determine $P$, the fraction of the 1000 simulations for which the three-year bias and precision criteria are met. $P$ is interpreted as the probability that the sampler is generating observations consistent with the three-year bias and precision DQOs.

The algorithms for determining whether the bias and precision DQOs have been achieved for each sampler follow.

**Bias Algorithm**

1. For each measurement pair, use Equation 4 from Element 14 to estimate the percent relative bias, $d_i$. To reiterate, this equation is

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} x100$$

**Equation 4**

where $X_i$ represents the concentration recorded by the primary sampler, and $Y_i$ represents the concentration recorded by the collocated sampler.

2. Summarize the percent relative bias to the quarterly level, $D_{j,q}$, according to

$$D_{j,q} = \frac{1}{n_{j,q}} \sum_{i=1}^{n_{j,q}} d_i$$

**Equation 12**

where $n_{j,q}$ is the number of collocated pairs in quarter $q$ for site $j$.

3. Summarize the quarterly bias estimates to the three-year level using

$$\hat{D}_j = \frac{\sum_{q=1}^{n_q} w_q D_{j,q}}{\sum_{q=1}^{n_q} w_q}$$

**Equation 1**

where $n_q$ is the number of quarters with actual collocated data and $w_q$ is the weight for quarter $q$ as specified by the scenario in Table 24-2.

4. Examine $D_{j,q}$ to determine whether one sampler is consistently measuring above or below the other. To formally test this, a non-parametric test will be used. The test is called the Wilcoxon Signed Rank Test and is described in *EPA QA/G-9*. If the null hypothesis is rejected, then one of the samplers is consistently measuring above or below the other. This information may be helpful in directing the investigation into the cause of the bias.

**Precision Algorithm**

1. For each measurement pair, calculate the coefficient of variation according to Equation 20 from Section 14 and repeated below:

$$CV_i = \frac{|d_i|}{\sqrt{2}}$$

**Equation 20**

2. Summarize the coefficient of variation to the quarterly level, $CV_{j,q}$, according to

$$CV_{j,q} = \sqrt{\frac{\sum_{i=1}^{n_j} CV_i^2}{n_{j,q}}}$$

**Equation**

where $n_{j,q}$ is the number of collocated pairs in quarter $q$ for site $j$.

3. Summarize the quarterly precision estimates to the three-year level using

$$\hat{CV}_j = \sqrt{\frac{\sum_{q=1}^{n_q} (w_q CV_{j,q}{}^2)}{\sum_{q=1}^{n_q} w_q}}$$

**Equation 2**

where $n_q$ is the number of quarters with actual collocated data and $w_q$ is the weight for quarter $q$ as specified by the scenario is Table 24-2.

4. If the null hypothesis in the Wilcoxon signed rank test was not rejected, then the coefficient of variation can be interpreted as a measure of precision. If the null hypothesis in the Wilcoxon signed rank test was rejected, the coefficient of variation has both a component representing precision and a component representing the (squared) bias.

**Confidence in Bias and Precision Estimates**

1. Follow the method described in Method for Estimating Confidence to estimate the probability that the sampler is generating observations consistent with the three-year bias and precision

DQOs. The resampling must be done for each collocated site.

**Summary of Bias and Precision Estimation**

The results from the calculations and re-sampling will be summarized in Table 24-3. There will be one line for each site operating a collocated sampler.

**Table 24-3. Summary of Bias and Precision**

| Collocated Site | Three-year Bias Estimate (Equation. 1) | Three-year Precision Estimate (Equation. 2) | Null Hypothesis of Wilcoxon Test Rejected? | *P* (Box 24-1) |
|---|---|---|---|---|
| A1 | | | | |
| B1 | | | | |

**Step 5. Draw Conclusions from the Data.**

Before determining whether the monitored data indicate compliance with the PM10 NAAQS, the District must first determine whether any of the assumptions upon which the statistical test is based are violated. This can be easily checked in Step 5 because of all the work done in Step 4. In particular, as long as

- in Table 24-1, there are no checks, and
- in Table 24-3,
- the three year bias estimate is in the interval [-10%,10%], and
- the three year precision estimate is less than or equal to 10%

then the assumptions underlying the test appear to be valid. As a result, if the observed three-year average PM concentration is less than 15 µg/m and the observed three-year average 98th percentile is less than 65 µg/m3, the conclusion is that the area seems to be in compliance with the PM NAAQS, with an error rate of 5%. If any of the assumptions have been violated, then the level of confidence associated with the test is suspect and will have to be further investigated.

**24.1.2 Action Plan Based on Conclusions from DQA**

A thorough DQA process will be completed during the summer of each year. Thorough means that all five steps of the process will be completed. Additionally, steps 2, Table 24-1, and Step 5 will be completed on a quarterly basis as a check to determine if something is changing with the monitoring or laboratory work that needs addressing before the annual review.

For this section, the District will assume that the assumptions used for developing the DQOs have been met. If this is not the case, the District must first revisit the impact of the violation on the bias and precision limits determined by the DQO process.

*DQA indicates every monitor operated by the District is collecting PM10 mass data that are within the precision and bias goals determined by the PM10 DQOs.*

If the conclusion from the DQA process is that each of the PM mass monitors are operating with less than 10% bias and 10% precision, then the District will pursue action to reduce the QA/QC burden. The basic idea is that once the District has demonstrated that it can operate within the precision and bias limits, it is reasonable to dedicate some of the PM QA/QC resources to other duties/tasks, such as modifying its QA monitoring or reducing some of its QC samplers or monitoring frequecy. Possible courses of action include the following.

- **Modifying the QA Monitoring Network**. 40 CFR Part 58 requires that each QA monitor be the same designation as the primary monitor, in the case that the primary monitor is an FRM. Once it is demonstrated that the data collected from the network are within tolerable levels of errors, the District may request that it be allowed to collocate with a single-day sampler instead. This will allow the District to establish a new site with the sequential sampler that had been the collocated sampler.

- **Reducing QC Requirements**. QC is integral to any ambient air monitoring network and is particularly important to new networks. However, once it is demonstrated that the data collected from the network are within tolerable levels of errors, then The District may request a reduction in the QC checks such as those specified in Table 23-1. However, if, during any of the annual DQA processes, it is determined that the errors in the data are approaching or exceed either the bias limits or the precision limits, then The District will return to the prescribed levels of QC checks as indicated in Table 23-1.

*DQA indicates at least one monitor operated by The District is collecting PM10 mass data that are not within the precision and bias goals determined by the PM10 DQOs.*

If and when the data from at least one of the collocated sites violates the DQO bias and/or precision limits, then the District will conduct an investigation to uncover the cause of the violation. If all of the collocated sites in the District violate the DQOs (across monitor designations), the cause may be at the District level (operator training) or higher (laboratory QC, problems with method designation). If only one site violates the DQOs, the cause is more likely specific to the site (particular operator, problem with site). The tools for getting to the root of the problem include: data from the collocated network (the District, nearby reporting organizations, national), data from FRM performance evaluations (the District, nearby reporting organizations, national), QC trails. Some particular courses of action include the following.

- **Determine level of aggregation at which DQOs are violated**. The DQA process can identify which monitors are having problems since the DQOs were developed at a monitor level. To determine the level at which corrective action is to be taken, it must be determined whether the violation of the DQOs is due to problems unique to one or two sites, unique to The District, or caused by a broader problem, like a particular sampler demonstrating poor QA on a national level. The District understands that AQS will generate QA reports summarizing bias and precision statistics at the national and reporting organization levels, and by method designation. These reports will assist The District in determining the appropriate level at which the DQOs are being violated. The procedure for determining level of violation is:

  * Review national reports for the method designations for which The District's DQA

process indicated a violation. If large bias or imprecision is seen at the national level, The District will request assistance from the Regional Office and OAQPS. If no problem seen at national level, The District will proceed looking at the QA reports specific to its neighboring reporting organizations.

* Review neighboring reporting organizations' precision and bias reports for the method designations for which The District's DQA process indicated a violation. If large bias or imprecision is seen in the neighboring organizations, The District will request assistance from the Regional Office. If no problem seen in the neighboring reporting organizations, the District will proceed looking at the QA reports specific to the District.
* Within The District, if the violations occur across method designations, then laboratory QC and training will be reviewed.
* Within The District, if the violations occur for only one method designation, the FRM performance evaluation data will be reviewed for confirmation with the collocated data. The FRM performance evaluation data may show that one of the monitors has a problem and must be repaired or replaced. The District will also use the national FRM performance evaluation summaries to see if The District is unique or like the national network. If The District is similar to the national picture, then assistance will be requested from the Regional Office and OAQPS. The results from the neighboring reporting organizations will also be reviewed. If the violations seem unique to The District, the District will continue investigating all the pieces that comprise the data.

- **Communication with Regional Office**. If a violation of the bias and precision DQOs is found, The District will remain in close contact with the Regional Y Office both for assistance and for communication.

- **Extensive Review of Quarterly Data until DQOs Achieved**. The District will continue to review extensively the quarterly QA reports and the QC summaries until the bias and precision limits are attained.

**References**

1. Data Quality Evalation Statistical Evaluation Toolbox (DataQUEST) EPA QA/G-9D U.S. Environmental Protection Agency, QAD EPA/600/R-96/085, December 1997

2. Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9 QA00 Update, Environmental Protection Agency, QAD EPA/600/R-96/084, July 2000

3. U.S. EPA Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule.
40 CFR Parts 53 and 58. *Federal Register*, **78** FR:3283. January 15, 2013.

4. U.S. EPA National Ambient Air Quality Standards for Particulate Matter - Final Rule.
40 CFR Part 50. *Federal Register*, **71** FR: 61224. October 17, 2006